FLUKE®

# Instruction Manual

**NOTE**

**This manual documents the Model 2201A and its assemblies at the revision levels shown in Appendix 7A. If your instrument contains assemblies with different revision letters, it will be necessary for you to either update or backdate this manual. Refer to the supplemental change/errata sheet for newer assemblies, or to the backdating sheet in Appendix 7A for older assemblies.**

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Model

# 2201A

## Scanner Chassis

P/N 456590

October 1976

REV. 1 12/78

# WARRANTY

Notwithstanding any provision of any agreement the following warranty is exclusive:

The JOHN FLUKE MFG. CO., INC., warrants each instrument it manufactures to be free from defects in material and workmanship under normal use and service for the period of 1-year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, disposable batteries (rechargeable type batteries are warranted for 90-days), or any product or parts which have been subject to misuse, neglect, accident or abnormal conditions of operations.

In the event of failure of a product covered by this warranty, John Fluke Mfg. Co., Inc., will repair and calibrate an instrument returned to an authorized Service Facility within 1 year of the original purchase; provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any instrument returned within one year of the original purchase, said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident or abnormal conditions of operations, repairs will be billed at a nominal cost. In such case, an estimate will be submitted before work is started, if requested.

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1. Notify the JOHN FLUKE MFG. CO., INC., or the nearest Service facility, giving full details of the difficulty, and include the Model number, type number, and serial number. On receipt of this information, service data or shipping instructions will be forwarded to you.

2. On receipt of the shipping instructions, forward the instrument, transportation prepaid. Repairs will be made at the Service Facility and the instrument returned, transportation prepaid.

**SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT**

All shipments of JOHN FLUKE MFG. CO., INC., instruments should be made via United Parcel Service or "Best Way" prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

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The JOHN FLUKE MFG. CO., INC. will be happy to answer all application or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO., INC., P.O. BOX 43210, MOUNTLAKE TERRACE, WASHINGTON 98043, ATTEN: Sales Dept. For European Customers: Fluke (Nederland) B.V., Zevenheuvelenweg 53, Tilburg, The Netherlands.

* For European customers, Air Freight prepaid.

**John Fluke Mfg. Co., Inc., • P.O. Box 43210 • Mountlake Terrace, Washington 98043**

Rev. 9/78

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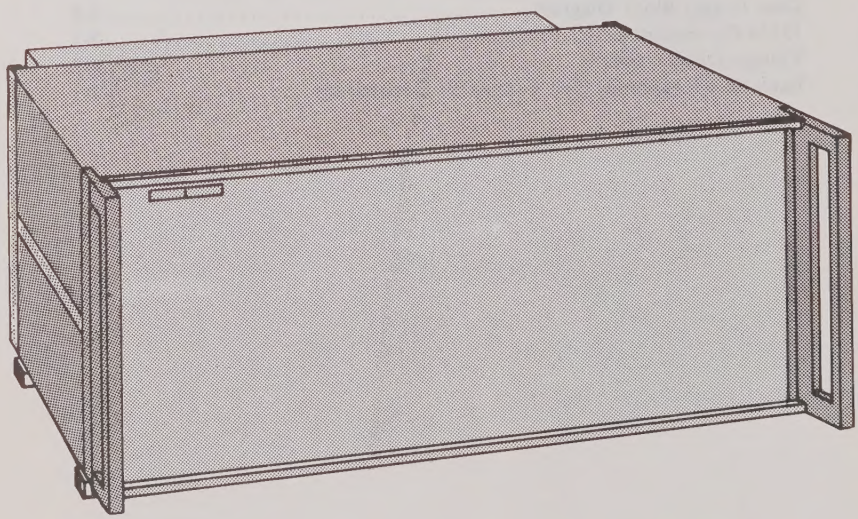
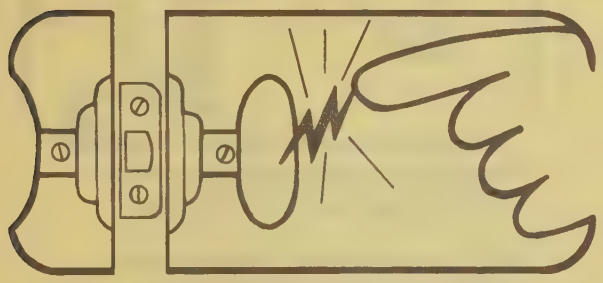


Model 2201A Scanner Chassis

# static awareness

A Message From

**John Fluke Mfg. Co., Inc.**

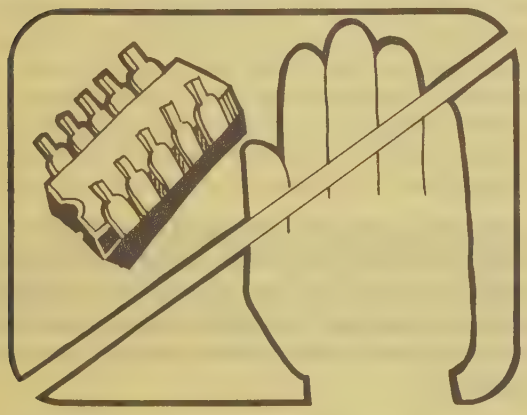


Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

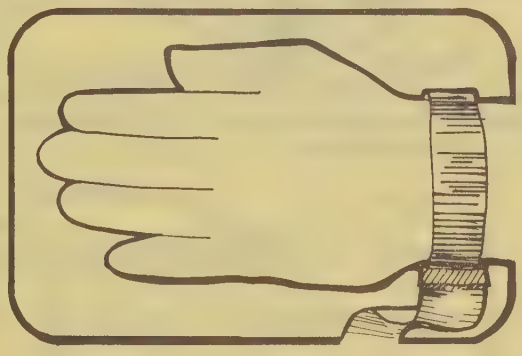
1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol "⊗".

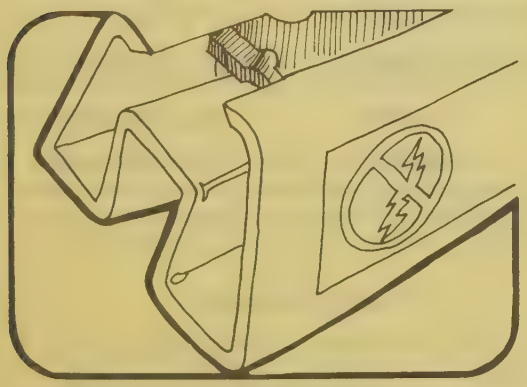
The following practices should be followed to minimize damage to S.S. devices.



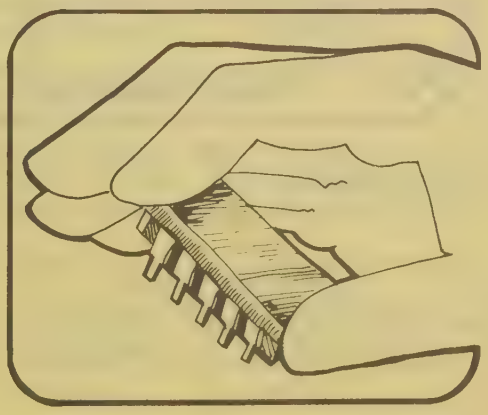
1. MINIMIZE HANDLING



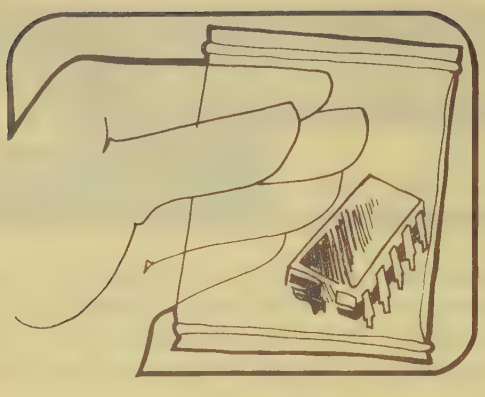
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES



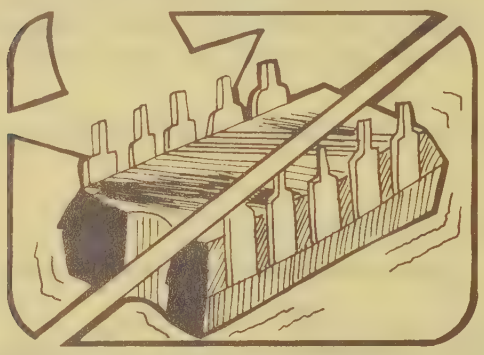
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



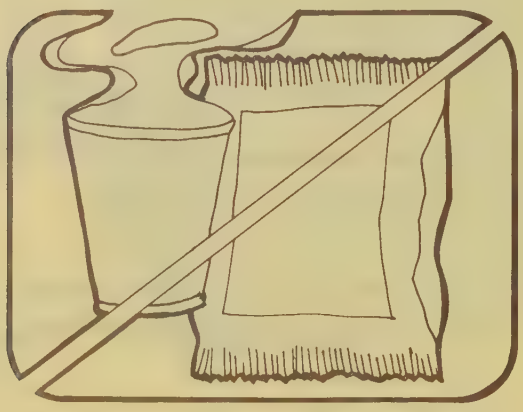
4. HANDLE S.S. DEVICES BY THE BODY



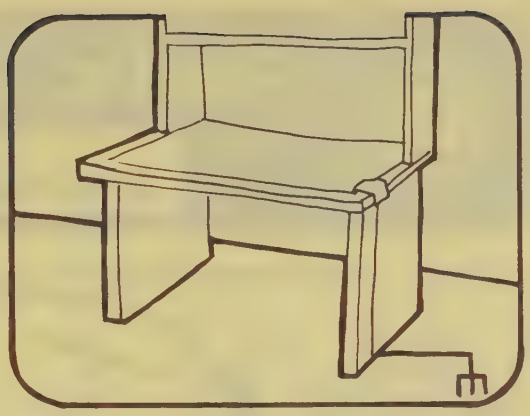
5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT



6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE



7. AVOID PLASTIC, VINYL AND STYRAFOAM IN WORK AREA



8. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION

9. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.

10. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

---

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

| John Fluke Part No. | Bag Size |
|---|---|
| 453522 | 6" x 8" |
| 453530 | 8" x 12" |
| 453548 | 16" x 24" |
| 454025 | 12" x 15" |

# Section 1
# Introduction & Specifications

## 1-1. INTRODUCTION

1-2. The Model 2201A Scanner Chassis is a data logging application oriented unit designed for use in expanding the physical channel capacity of the Fluke 2200A Data Logger to 100 channels maximum and the 2240A Data Logger to 1000 channels maximum. The scanner chassis interfaces directly with the data logger and operates as a fully guarded extension of the input section. A serial type interface is employed so that multiple scanner chassis can be interfaced, in any combination up to 10 maximum, via a single interface port at the rear of the data logger.

1-3. The 2200A and 2240A Data Loggers are capable of servicing a maximum of 100 and 1000 channels, respectively. However, their scanner capacity is physically limited to 60 channels. Therefore, to establish the capacity for a full complement of channels, one or more 2201A's required. Each 2201A Scanner Chassis is a mechanical housing that provides slots for twelve -05 General Purpose or -06 Low Level Scanners. Any combination of General Purpose or Low Level Scanners may be installed in a single 2201A.

1-4. The 2201A includes a guarded interface cable 6 feet long as standard equipment for connection to the 2200A or 2240A Data Logger. An accessory cable is available to permit remote operation of the 2201A up to 50 feet from the data logger.

## 1-5. SPECIFICATIONS

1-6. Specifications for the 2201A are given in Table 1-1.

**Table 1-1. 2201A Specifications**

**CAPACITY — Twelve Scanners (120 channels)**

Connection of a 2201A Scanner Chassis to a 2200A or 2240A Data Logger increases the channel capacity of the data logger. All data logger specifications remain the same with the following exceptions.

*NOTE: For these specification statements to apply when a 2201A Scanner Chassis is interconnected to a 2200A or 2240A Data Logger, the interconnecting cable must be mechanically secured and stabilized.*

**SYSTEM ACCURACY**

A single 2201A Scanner Chassis with 6 foot cable has negligible effect on the data logger accuracy statement. The effect on data logger accuracy of additional scanner chassis or longer interconnecting cable is to increase the low level noise. The amount of this increase is proportional to the size of the system.

| System Description* | Accuracy Degradation (add to Data Logger Accuracy Statement) | |
|---|---|---|
| | Slow Speed | Fast Speed |
| 2200A or 2240A and eight 2201A Scanner Chassis (each with 6 foot cable) | Add 3 μV | Add 5 μV |

**NOTE: This system and most other systems will result in significant errors on only the 40 mV (1 μV resolution) range.*

Table 1-1. 2201A Specifications (cont)

### TEMPERATURE ACCURACY

No additional factors need be considered for degradation (drift) of the Temperature Accuracy Statement.

### COMMON MODE REJECTION

A) Data Logger only:
Slow Speed: 140 dB at 50 Hz or 60 Hz ±0.1%, 120 dB at DC with 1 kΩ unbalance.
Fast Speed: 110 dB at 50 Hz or 60 Hz ±0.1%, 120 dB at DC with 1 kΩ unbalance.

B) Data Logger with one 2201A and 6 foot interconnect cable: 3 dB CMR reduction for both fast and slow speed. (Subtract dB value from data logger CMR specification.)

C) Data Logger with eight 2201A's (each with 6 foot cable): 10 dB CMR reduction for both fast and slow speed.

D) Data Logger with one 2201A and 50 foot interconnect cable: 10 dB CMR reduction for both fast and slow speed.

### CHANNEL DIFFERENTIAL CMR

$$\text{Diff CMR} = \frac{\text{n channel reading error (volts)}}{\left[\left({}^{V}\text{Com. Mode for Chan. N-1}\right) - \left({}^{V}\text{Com. Mode for Chan. N}\right)\right]}$$

A) Data Logger only:
Slow Speed: 140 dB
Fast Speed: 120 dB

B) Data Logger with one 2201A and 6 foot interconnect cable: 3 dB Diff CMR reduction for both fast and slow speed.

C) Data Logger with eight 2201A's (each with 6 foot cable): 10 dB Diff CMR reduction for both fast and slow speed.

D) Data Logger with one 2201A and 50 foot interface cable: 10 dB Diff CMR reduction for both fast and slow speed.

*NOTE: Minimum CMR for data logger system [= NMR at 50 Hz or 60 Hz]*

Slow Speed: 80 dB at 50 Hz or 60 Hz ±0.1%
Fast Speed: 63 dB at 50 Hz or 60 Hz ±0.1%

### INTERCONNECT CABLE LENGTH

2201A can be located up to 50 feet from data logger.

### POWER REQUIREMENTS

None — no ac power line connection required. Draws <1 watt from the data logger.

### SIZE

17.78 cm (7 in) H, 43.18 cm (17 in) W, 40.64 cm (16 in) D including rear cover (see Figure 1-1)

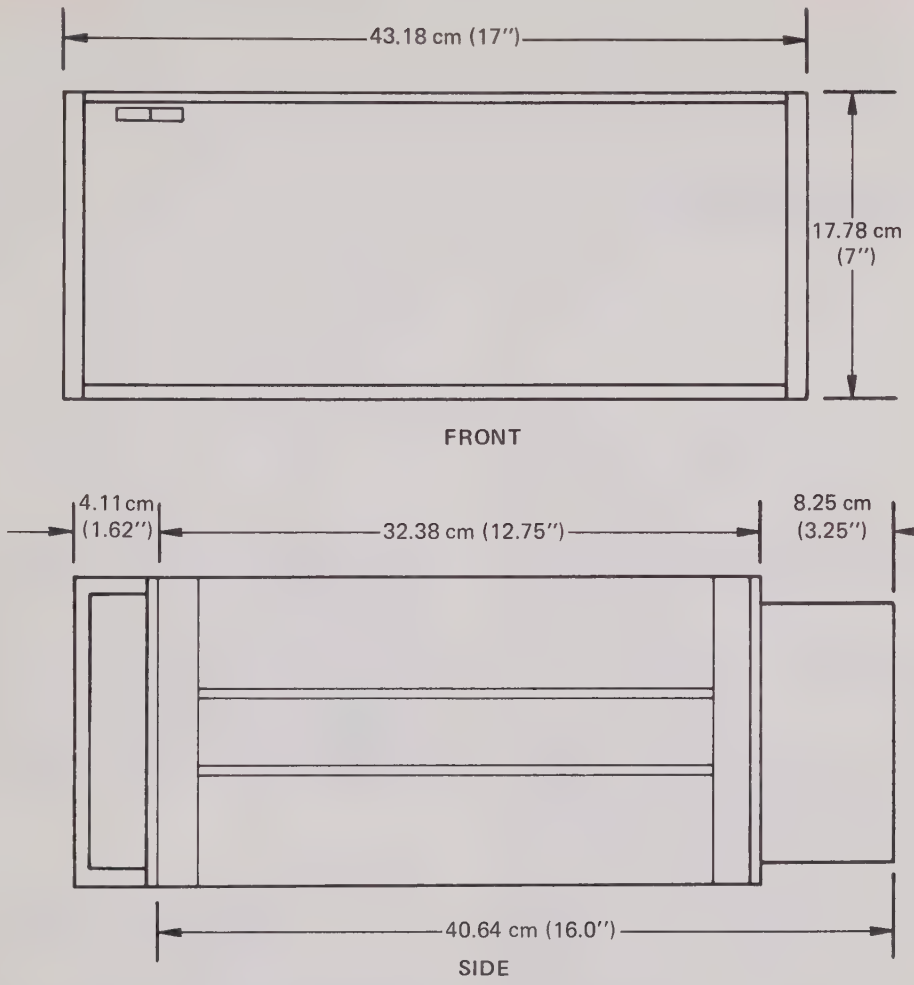



**Figure 1-1. Outline Drawing**

# Section 2
# Operating Instructions

## 2-1. INTRODUCTION

2-2. This section of the manual contains information regarding installation and operation of the Model 2201A Scanner Chassis. It is recommended that this section be read and understood before attempting to operate the instrument. If difficulties are encountered during operation, please contact your nearest Fluke Technical Center or John Fluke Mfg. Co., Inc., P.O. Box 43210, Mountlake Terrace, WA 98043; telephone (206) 774-2211. A list of Technical Service Centers is located at the back of this manual.

## 2-3. SHIPPING INFORMATION

2-4. Upon receipt of the instrument, a thorough inspection should be made to reveal any shipping damage. Special instructions for inspection and filing damage claims are included in the shipping carton.

2-5. If reshipment is necessary, the original container should be used. If the original container is not available, a new one can be obtained from the John Fluke Mfg. Co., Inc. The instrument model number should be referenced when requesting a new shipping container.

## 2-6. INPUT POWER

2-7. The Model 2201A operates from +5 volt power received from the data logger to which it is connected. Alternately, it operates from +5 volt power received from a preceding interface Model 2202A or 2203A whenever such a combination of scanner chassis are used. The Model 2201A becomes fully operational at turn-on of the data logger to which it is connected.

## 2-8. RACK INSTALLATION

2-9. An accessory rack mounting kit and rack slide kit are available for the 2201A. Refer to Section 6 of this manual for description and installation instructions.

## 2-10. CHANNEL ADDRESS ASSIGNMENTS

2-11. Prior to operation, the Channel-Identification Code must be assigned to the 2201A. This code is used to define the channel addresses for the scanner slots contained in each 2201A and is independent of the units' position in the control chain. The code is entered on two thumbwheel switches located under the 2201A's top cover. The switches are manually set to identify the first channel to occur in BLOCK 0. Consecutive channel addresses are automatically assigned to the remaining scanner blocks (1 through 11). The location of the Channel-Identification switches and the channel assignments that result from a switch setting of 06 (Channel 060) are shown in Figure 2-1. The units digit is always zero and cannot be set. Use the following procedure to set the Channel-Identification Code switches in each 2201A:

*NOTE*

*Multiple 2201A's may be interfaced into a single data logger system. Overlapping or redundant Channel-Identification Codes should be avoided; otherwise, channels with like assignments will be operated simultaneously, when commanded.*

1. Turn data logger power OFF.

2. Remove the top dust cover and inner guard cover from the 2201A.

**WARNING**

**TO PREVENT ELECTRIC SHOCK, REFER INSTRUMENT DISASSEMBLY PROCEDURES TO QUALIFIED SERVICE PERSONNEL.**

3. Refer to Figure 2-1, and locate the Channel-Identification Switches.

4. Set the Hundreds switch to the most significant digit of the desired three-digit address code (100, 200, 300, etc.). If the address is less than 100 set it to zero.

5. Set the Tens switch to the second digit of the three-digit address codes (000, 010, 020, 030, etc.). The least significant digit of the address code cannot be set and is always zero.

6. Replace the inner guard cover and top dust cover.

7. Turn data logger power ON.

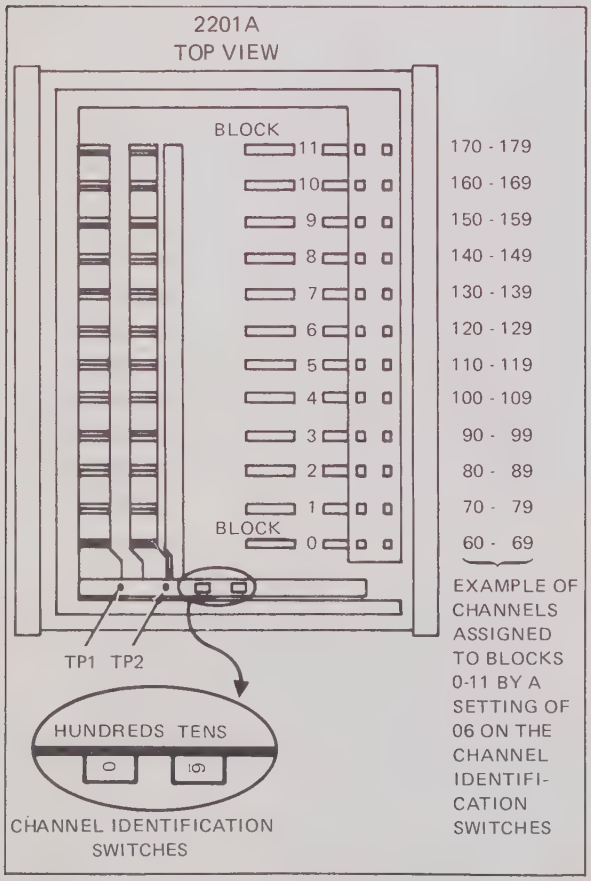



**Figure 2-1. 2201A Channel Address Switch Locations and Example of Switch Settings**

## 2-12. CONTROL CABLE CONNECTIONS

2-13. Each 2201A is equipped with a 6 foot guarded interface cable as standard equipment for connection to connectors J3 and J4 on the rear panel (see Figure 2-2). Interconnect the data logger and one or more 2201A's as shown in Figure 2-3. Connector J4 on the last (or only) unit in the chain is not used. Note that the 2201A is designed to operate up to 50 feet from the data logger. For operation at any distance beyond 6 feet, up to the 50 foot maximum, an accessory Remote Scanner Chassis Cable (2200A-7002) and Connector Assembly (2200A-7001) must be ordered (refer to Section 6 of this manual for accessory information). If multiple 2201A's are used in a data logger system, the distance to the last 2201A in the series should not exceed 50 feet.

2-14. One or more 2201A's may be connected to an interfaced Fluke 2202A Remote Scanner Chassis or 2203A RTD Scanner Chassis, permitting 2201A operation at remote locations. The 2202A and 2203A are designed to operate up to 1500 feet from the interfaced data logger. The 2201A may be operated up to 50 feet from either the 2202A or 2203A. Cable connections between units are the same as described for the 2201A data logger system.

## 2-15. SCANNER INSTALLATION

2-16. Refer to the Option -05 and -06 subsections in Section 6 of the data logger manual for scanner pcb installation instructions. Install the appropriate scanners in the desired slots.

## 2-17. INPUT CONNECTORS

2-18. Refer to the Option -07 and -08 subsections in Section 6 of the data logger manual for scanner input connector installation instructions. Install the input connectors in the desired slots.

## 2-19. OPERATION

2-20. Once installed, the 2201A requires no operator attention. Instructions for programming the operation of all scanners from the data logger's front panel are included in Section 2 of the data logger manual.

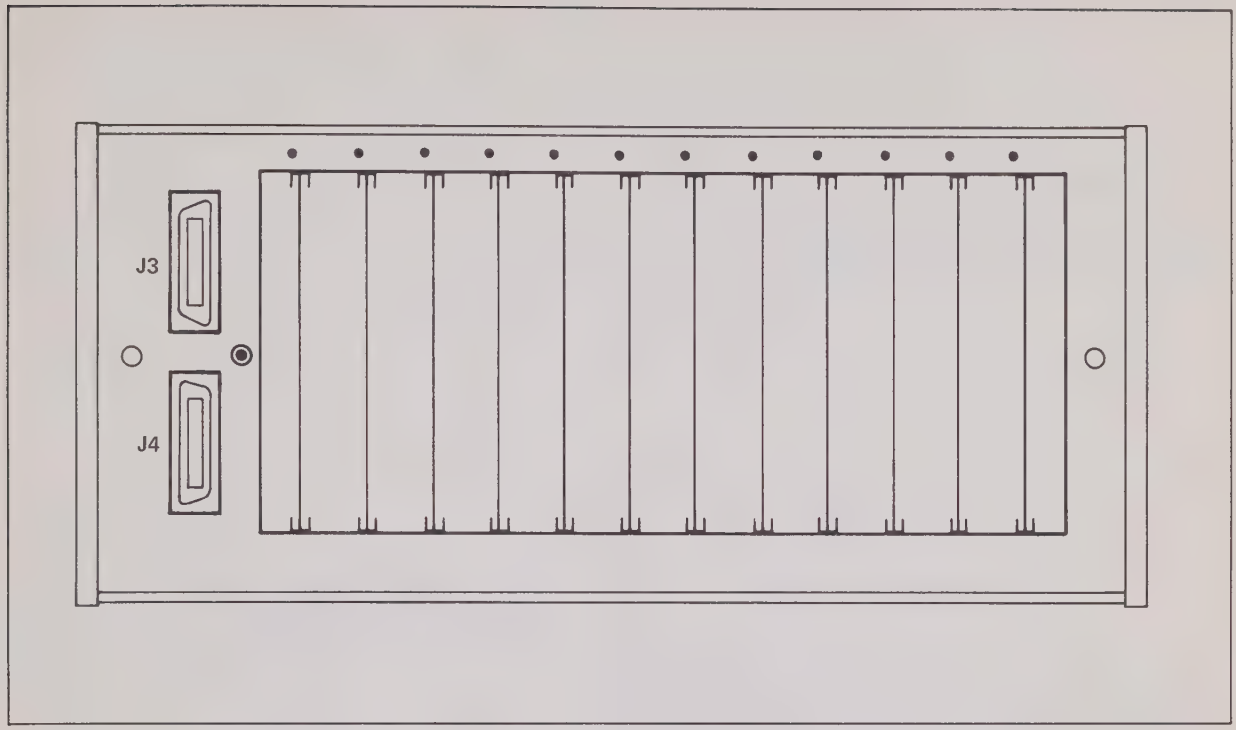



Figure 2-2. 2201A Rear Panel Connectors

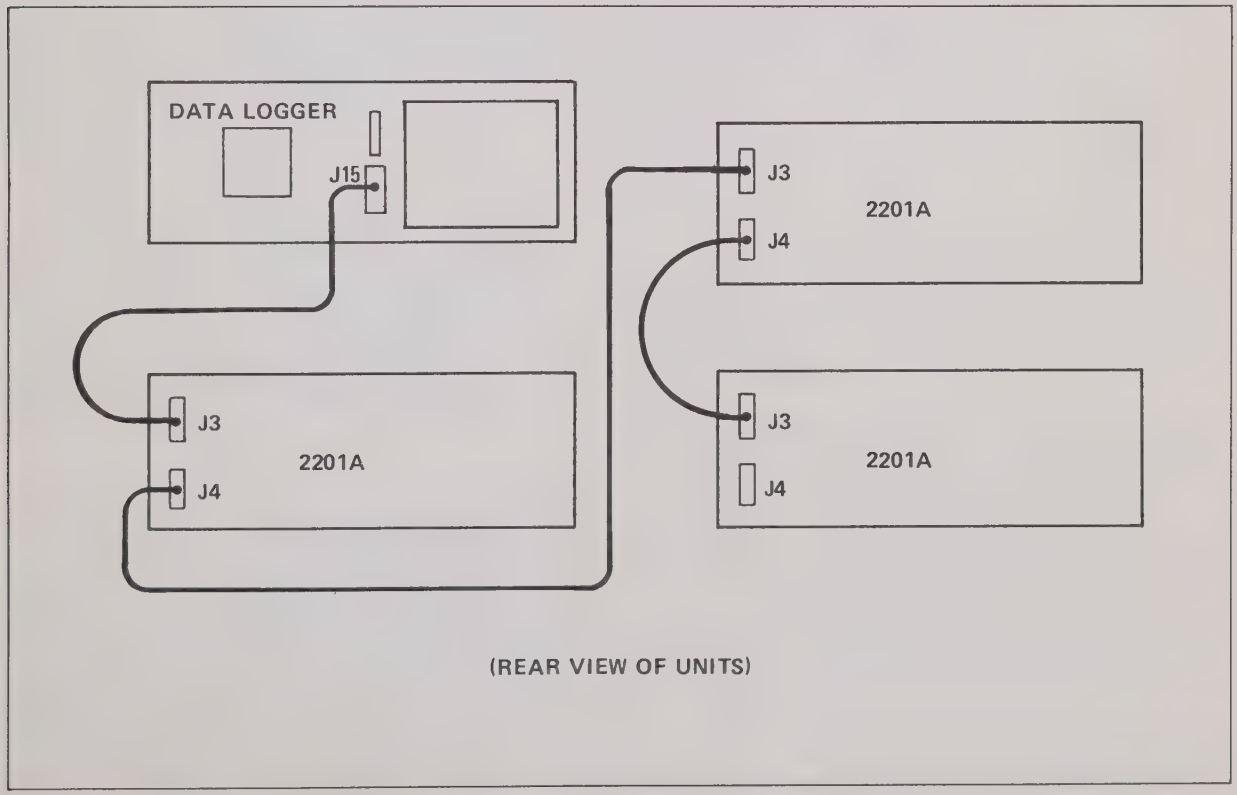



Figure 2-3. 2201A Cable Connections

# Section 3
# Theory of Operation

## 3-1. INTRODUCTION

3-2. This section of the manual contains overall functional description followed by a circuit analysis of the 2201A Scanner Chassis. Detailed schematics are located in the back of this manual.

## 3-3. OVERALL DESCRIPTION

3-4. The Model 2201A provides data logger input channel expansion capability as shown in the Data Logger Block Diagram, Figure 3-1. The 2201A will accommodate up to 12 scan cards (120 channels). The instrument is powered by +5V dc received from the data logger to which it is connected.

3-5. Several 2201A's may be connected in series to one data logger to provide up to 1000 channels of low level analog multiplexing for the 2240A Data Logger or 100 channels for the 2200A Data Logger. The first (or only) 2201A Scanner Chassis in a series is connected to a rear panel connector on the data logger. Additional scanner chassis are connected to connectors J3 and J4 as shown in Figure 2-3.

3-6. Each 2201A is equipped with a cable assembly that allows two or more units to be connected in serial or "daisy chain" fashion. (The first unit in the chain is connected to the data logger.) These cables carry the channel select commands (0 through 999), the analog signal from the selected channel, the reference and sense lines necessary to make thermocouple measurements and the +5V dc needed to power each 2201A. A total of 100 mA is available from the +5 volt supply. Less than 1 mA is required to operate the 2201A when no channel relays are operated.

## 3-7. CIRCUIT ANALYSIS

## 3-8. Input/Output Connectors

3-9. Input connector J3 accepts the input cable from the rear panel of the data logger. Output connector J4 provides cable connections for additional scanner chassis. Both connectors have identical pin assignments as shown in Figure 3-2.

3-10. The following 12 lines incoming on J3 are dedicated to supplying the 1-2-4-8 bcd information necessary to select the desired channel.

| Channel Units | Channel Decade | Channel Hundreds |
|---|---|---|
| CH S0 1 bit | DS0 1 bit | HS0 1 bit |
| CH S1 2 bit | DS1 2 bit | HS1 2 bit |
| CH S2 4 bit | DS2 4 bit | HS2 4 bit |
| CH S3 8 bit | DS3 8 bit | HS3 8 bit |

3-11. Only legal 1-2-4-8 bcd codes (0 to 9) are allowed. An illegal code will result in the wrong channel or channels being selected. Once selected, HI, LO and GUARD of the desired channel are connected to pins 35, 17 and 4 of J3, respectively.

3-12. Four other signal lines are dedicated to making reference junction measurement necessary in the linearization of thermocouple inputs as follows:

| | |
|---|---|
| A-D Common, REF Common | Connected together at the A-D converter in the data logger. |
| 6.2V | Reference voltage supplied to the isothermal blocks within the 2201A (supplied by the A-D converter). |
| Temp. Sig. | A calibrated signal that indicates the temperature of the isothermal block (0.5400V at 25°C). |

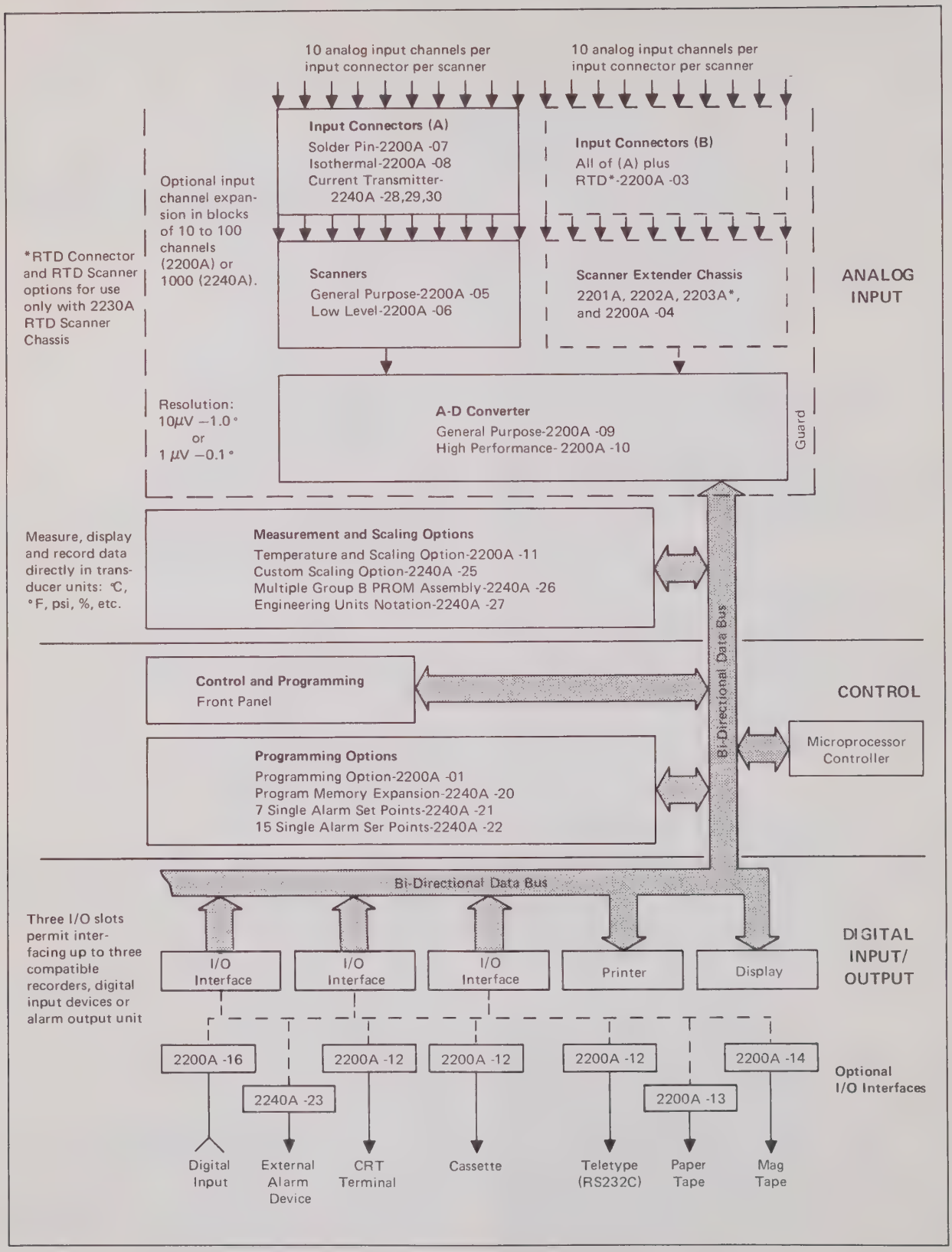



Figure 3-1. Data Logger Block Diagram

| | | | |
|---|---|---|---|
| CHASSIS | 1 | 19 | CHASSIS |
| N/C | 2 | 20 | N/C |
| N/C | 3 | 21 | N/C |
| GUARD | 4 | 22 | GUARD |
| N/C | 5 | 23 | N/C |
| HS0 | 6 | 24 | HS1 |
| HS2 | 7 | 25 | HS3 |
| DS0 | 8 | 26 | DS1 |
| DS2 | 9 | 27 | DS3 |
| CH S0 | 10 | 28 | CH51 |
| CH S2 | 11 | 29 | CH53 |
| N/C | 12 | 30 | 6.2V |
| GL +5 | 13 | 31 | GL +5 |
| GL COM | 14 | 32 | GL COM |
| A/D COM | 15 | 33 | REF COM |
| TEMP SIG | 16 | 34 | N/C |
| LO | 17 | 35 | HI |
| N/C | 18 | 36 | N/C |

Figure 3-2. J3/J4 Pin Assignments

## 3-13. Bank Select Assembly

3-14. The Bank Select Asssembly provides the control logic required by the 2201A for proper assignment and selection of scanner channels. Two thumbwheel switches, S1A and S1B, are used to manually set the channel identity for each 2201A. All other scan card positions are automatically assigned consecutive numbers based on the number assigned to channel 0. For example, with S1B and S1A set at "1" and "2" respectively, the first scan card (BLOCK 0) will be assigned channels 120 through 129, the next scan card (BLOCK 1) channels 130 through 139 and so on. The last scan card (BLOCK 11 in the 2201A) will be assigned channels 230 through 239.

3-15. Once the thumbwheel switches have been set and the system is operating, the desired channel is selected by taking the decade and hundreds digits of the input channel address (DS0 through DS3 and HS0 through HS3 respectively) and subtracting the manually set "identity" address taken from switches S1A and S1B. This computation is performed by a pair of natural bcd adders, U3 and U4. If the result of this subtraction is greater than zero and less than 12, then the bcd coded number is decoded by U7 and the desired scan card (BLOCK 0 to 11) will be selected.

3-16. The units digit of the input channel address (CH S0 through CH S3) selects the proper channel on that card. Once a scan card is selected, relay K1 is energized, connecting the "6.2V" reference and the "Temp. Sig." to the proper inputs on the data logger a-d converter. This action is necessary when making a reference junction reading on the input channels in the 2201A Scanner Chassis.

## 3-17. Mother Board PCB Assembly

3-18. Connectors P2 and P1 on the Bank Select PCB Assembly mate with connectors J2 and J1 respectively on the Mother Board PCB Assembly. Connector J2 provides block select, channel select, +5V and common, guard and 6.2V to scan card connector J11, BLOCK 0 to 11. Connector J1 provides HI and LO signal lines, Temp Sig, REF Command A-D Com to scan card connector J12, BLOCK 0 to 11.

# Section 4
# Maintenance

**WARNING**

**THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.**

## 4-1. INTRODUCTION

4-2. This section of the manual contains maintenance information for the Model 2201A Scanner Chassis, including general maintenance and performance tests. The performance test is recommended as an acceptance test when the instrument is first received and, later, as a preventative maintenance tool to verify specifications after repair. The 2201A does not require calibration. Table 4-1 lists the equipment required for servicing the instrument. If the recommended model is not available, a substitute meeting the minimum use specifications may be used.

Table 4-1. Test Equipment Requirements

| Instrument Type | Minimum Use Specifications | Recommended Model |
|---|---|---|
| DC Voltmeter | Accuracy: ±0.1%<br>Resolution: 1 mV | Fluke Model 8000A |
| Resistors | 1 kΩ, ±0.05%, ½W<br>Quantity: 10 each | Dale Type RS-½ |
| DC Voltage Calibrator | Output Voltage: 1.0000V<br>Resolution: 10 μV | Fluke Model 343A |

## 4-3. SERVICE INFORMATION

4-4. The 2201A is warranted for a period of one year upon delivery to the original purchaser. The WARRANTY is located on the back of the title page located in the front of this manual.

4-5. Factory Authorized calibration and service for each Fluke product is available at various worldwide locations. A complete list of these service centers is included in Section 7 of this manual. If requested, an estimate will be provided to the customer before any work is begun on instruments that are beyond the warranty period.

## 4-6. CLEANING

4-7. Clean the 2201A periodically to remove dust, grease and other contamination. Use the following procedure:

**CAUTION**

**Do not use aromatic hydrocarbons or chlorinated solvents to clean the 2201A. They will react with the plastic materials used in the instrument.**

1. Clean the front panel and case with a soft cloth dampened with a mild solution of detergent and water.

2. Clean the surface of the pcb's using clean, dry air at low pressure (≤20 psi). If grease is encountered, spray with Freon T.F. Degreaser and remove grime with clean, dry air at low pressure.

## 4-8. PERFORMANCE TEST

## 4-9. Supply Voltage Check

1. Turn data logger power OFF.

2. Connect the Model 2201A Scanner Chassis to either a Model 2240A or 2200A Data Logger using the interface cable supplied with the 2201A. Connect the cable from rear panel connector J3 on the 2201A to J15 on the data logger A-D converter board, accessible through an access port on the rear panel of the data logger.

3. Connect voltmeter between TP2 and TP1 (ground) on the Bank Select PCB (see Figure 2-1 for test point locations).

4. Turn data logger power ON and verify that 5.0 ±0.25 volts dc is preset at TP2.

## 4-10. Control Logic Check - Bank Select Assembly

4-11. This procedure verifies proper operation of the Bank Select Assembly. DC test voltages are applied to each scanner channel in each scanner position in the 2201A. The data logger is then programmed to select and read the input test voltage in each channel.

1. Turn data logger power OFF.

2. Install either a 2200A-05 General Purpose Scanner or 2200A-06 Low Level Scanner into each scan card slot in the 2201A.

3. Set thumbwheel switches S1A and S1B on the Bank Select PCB to "00".

*NOTE*

*The data logger mainframe must not have any scanners installed for the purposes of this test.*

4. Fabricate a resistive voltage divider using either the 2200A-07 Solder Pin Connector or the 2200A-08 Isothermal Connector as shown in Figure 4-1.

5. Attach the voltage divider and connector from step (4) to the BLOCK 0 position scanner in the 2201A and connect the DC voltage calibrator to the voltage divider as shown in Figure 4-2.

6. Set the DC voltage calibrator for an output of 1.0000 volts dc.

7. Program the data logger to the 4V range with FIRST CHANNEL set to 000 and LAST CHANNEL set to 009.

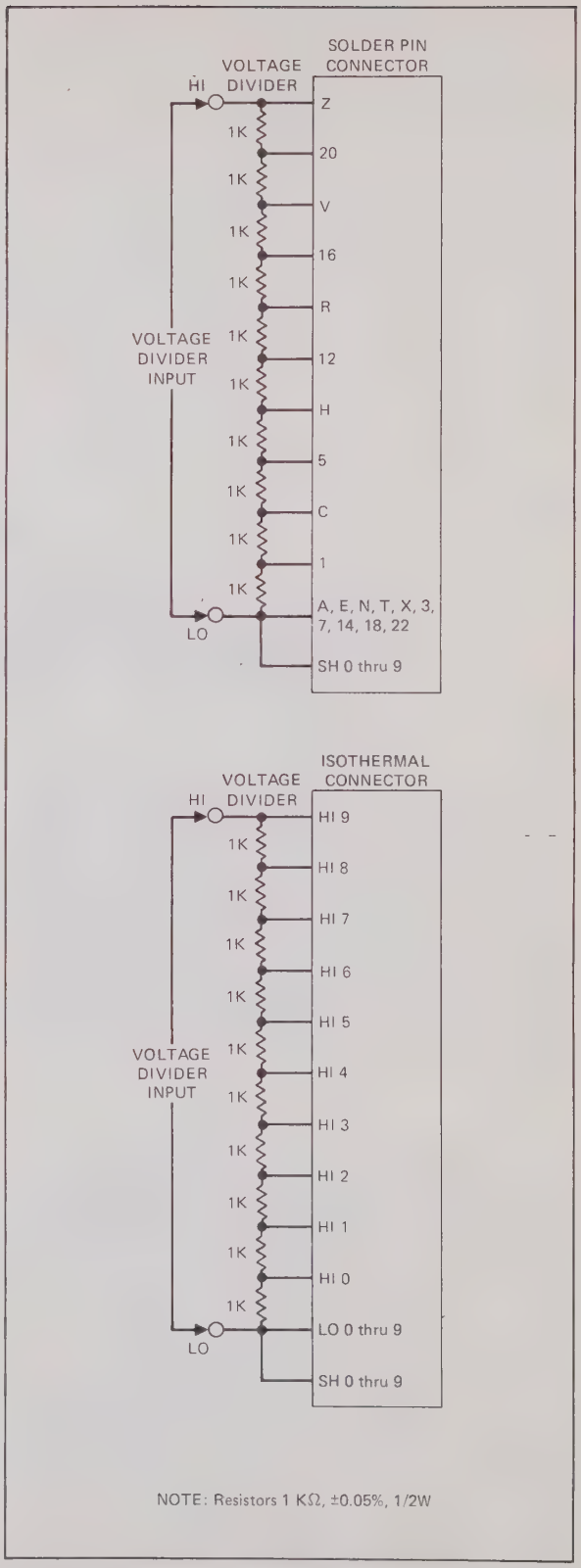



**Figure 4-1. Voltage Divider Details**

8. Initiate a SINGLE scan with PRINTER ON and verify that the channels in scanner BLOCK 0 read as shown in Table 4-2, ±5 digits.

9. Repeat steps (5) through (8) for 2201A scanner BLOCK 1 through BLOCK 11 positions, reprogramming FIRST and LAST CHANNEL each time.

10. Reattach the voltage divider and connector and DC voltage calibrator to scanner BLOCK 0 position as in step (5).

11. Step thumbwheel switches S1A and S1B through all 10 positions and program the data logger to monitor FIRST CHANNEL in the 2201A for each setting as shown in Table 4-3. Verify reading obtained for each channel is 0.1V ±5 digits.

12. This concludes performance tests of the Model 2201A. Turn OFF power and disconnect test equipment.

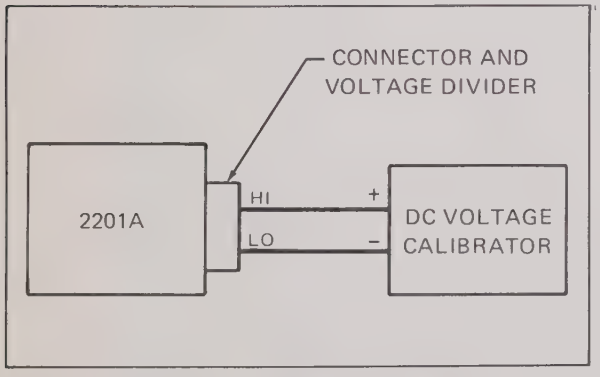



Figure 4-2. Bank Select Assembly Test Equipment Connections

Table 4-2. Block 0 Channel Readings

| Channel | Reading |
|---|---|
| 0 | 0.1000V |
| 1 | 0.2000V |
| 2 | 0.3000V |
| 3 | 0.4000V |
| 4 | 0.5000V |
| 5 | 0.6000V |
| 6 | 0.7000V |
| 7 | 0.8000V |
| 8 | 0.9000V |
| 9 | 1.0000V |

Table 4-3. Thumbwheel Switch Settings

| S1A, B Switch Setting | | Data Logger Channel Programmed |
|---|---|---|
| Hundreds | Tens | |
| 0 | 0 | 000 |
| 0 | 1 | 010 |
| 0 | 2 | 020 |
| 0 | 3 | 030 |
| 0 | 4 | 040 |
| 0 | 5 | 050 |
| 0 | 6 | 060 |
| 0 | 7 | 070 |
| 0 | 8 | 080 |
| 0 | 9 | 090 |
| 1 | 0 | 100 |
| 2 | 0 | 200 |
| 3 | 0 | 300 |
| 4 | 0 | 400 |
| 5 | 0 | 500 |
| 6 | 0 | 600 |
| 7 | 0 | 700 |
| 8 | 0 | 800 |
| 9 | 0 | 900 |

# Section 5
# List of Replaceable Parts

## TABLE OF CONTENTS


| TITLE | TABLE | PAGE | FIGURE | PAGE |
|---|---|---|---|---|
| 2201A Scanner Chassis Final Assembly | 5-1 | 5-3 | 5-1 | 5-4 |
| A1 Mother Board PCB Assembly | 5-2 | 5-7 | 5-2 | 5-7 |
| A2 Bank Select PCB Assembly | 5-3 | 5-8 | 5-3 | 5-9 |

## 5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. A similar parts listing for each of the Options will be found in Section 6. Components are listed alphanumerically by assembly. Both electrical and mechanical components are listed first by reference designation and second by item number. Each listed part is shown in an accompanying illustration.

5-3. Parts lists include the following information:

1. Reference Designation or Item Number.

2. Description of each part.

3. FLUKE Stock Number.

4. Federal Supply Code for Manufacturers. (See Section 7 for Code-to-Name list.)

5. Manufacturer's Part Number or Type.

6. Total Quantity per assembly or component.

7. Recommended Quantity: This entry indicates the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc., that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended quantity of the item in that particular assembly.

## 5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions if necessary.

5-6. To ensure prompt and efficient handling of your order, include the following information.

1. Quantity.

2. FLUKE Stock Number.

3. Description.

4. Reference Designation or Item Number.

5. Printed Circuit Board Part Number.

6. Instrument Model and Serial Number.

**CAUTION**

**Indicated devices are subject to damage by static discharge.**

Table 5-1. 2201A Scanner Chassis Final Assembly

| ITEM NO. | DESCRIPTION | FLUKE STOCK NO. | MFG SPLY CODE | MFG PART NO. OR TYPE | TOT QTY | REC QTY | USE CDE |
|---|---|---|---|---|---|---|---|
| | Ⓐ FINAL ASSEMBLY FIGURE 5-1 | ORDER | MODEL | 2201A | | | |
| A1 | MOTHER BOARD PCB ASSEMBLY | 419465 | 89536 | 419465 | 1 | | |
| A2 | Ⓐ BANK SELECT PCB ASSEMBLY | 419622 | 89536 | 419622 | 1 | | |
| H1 | SCREW, 4-40 X 1/4 PHP | 185918 | 89536 | 185918 | 17 | | |
| H2 | SCREW, 6-32 X 1/4 FHP | 320093 | 89536 | 320093 | 12 | | |
| H3 | SCREW, 6-32 X 1/4 PHP | 178533 | 89536 | 178533 | 8 | | |
| H4 | SCREW, 6-32 X 3/8 PHP | 177022 | 89536 | 177022 | 16 | | |
| H5 | SCREW, 6-32 X 1/2 PHP | 177030 | 89536 | 177030 | 4 | | |
| H6 | SCREW, CAP, 8-32 | 295105 | 89536 | 295105 | 4 | | |
| H7 | SCREW, 8-32 X 3/8 FHP | 114116 | 89536 | 114116 | 8 | | |
| H8 | SCREW, 8-32 X 1/2 FHP | 114355 | 89536 | 114355 | 10 | | |
| MP1 | BRACKET, ISO-THERMAL SUPPORT | 419556 | 89536 | 419556 | 1 | | |
| MP2 | CHAMBER, GUARD | 419564 | 89536 | 419564 | 1 | | |
| MP3 | CHAMBER, GUARD, BOTTOM | 419481 | 89536 | 419481 | 1 | | |
| MP4 | CHASSIS, SIDE | 419580 | 89536 | 419580 | 2 | | |
| MP5 | CORNER, REAR | 423814 | 89536 | 423814 | 2 | | |
| MP6 | COVER, BOTTOM | 419515 | 89536 | 419515 | 1 | | |
| MP7 | COVER, GUARD CHAMBER | 419531 | 89536 | 419531 | 1 | | |
| MP8 | COVER, REAR | 412387 | 89536 | 412387 | 1 | | |
| MP9 | COVER, TOP | 419523 | 89536 | 419523 | 1 | | |
| MP10 | DECAL, CORNER | 296277 | 89536 | 296277 | 4 | | |
| MP12 | DECAL, REAR PANEL | 428219 | 89536 | 428219 | 1 | | |
| MP13 | DECAL, SIDE TRIM | 295378 | 89536 | 295378 | 2 | | |
| MP14 | FOOT, BAIL STAND | 292870 | 89536 | 292870 | 1 | | |
| MP15 | FOOT, BAIL WIDTH | 231407 | 89536 | 231407 | 1 | | |
| MP16 | GUIDE, CARD | 298461 | 89536 | 298461 | 37 | | |
| MP17 | GUIDE, CARD | 256461 | 23888 | 1450F | 13 | | |
| MP18 | HANDLES, FRONT | 423053 | 89536 | 423053 | 2 | | |
| MP19 | HANDLE, TRIM | 295501 | 89536 | 295501 | 2 | | |
| MP20 | INSULATOR, FASTENER | 372342 | 89536 | 372342 | 25 | | |
| MP21 | PANEL, FRONT | 419630 | 89536 | 419630 | 1 | | |
| MP22 | PANEL, REAR | 419598 | 89536 | 419598 | 1 | | |
| MP23 | SPACER, INSULATED | 372334 | 89536 | 372334 | 25 | | |
| MP24 | STIFFENER, MOTHER BOARD | 419499 | 89536 | 419499 | 1 | | |
| W1 | CABLE ASSEMBLY, INTERFACE | 420430 | 89536 | 420430 | 1 | | |
| | INSTRUCTION MANUAL (NOT SHOWN) | 456590 | 89536 | 456590 | 1 | | |

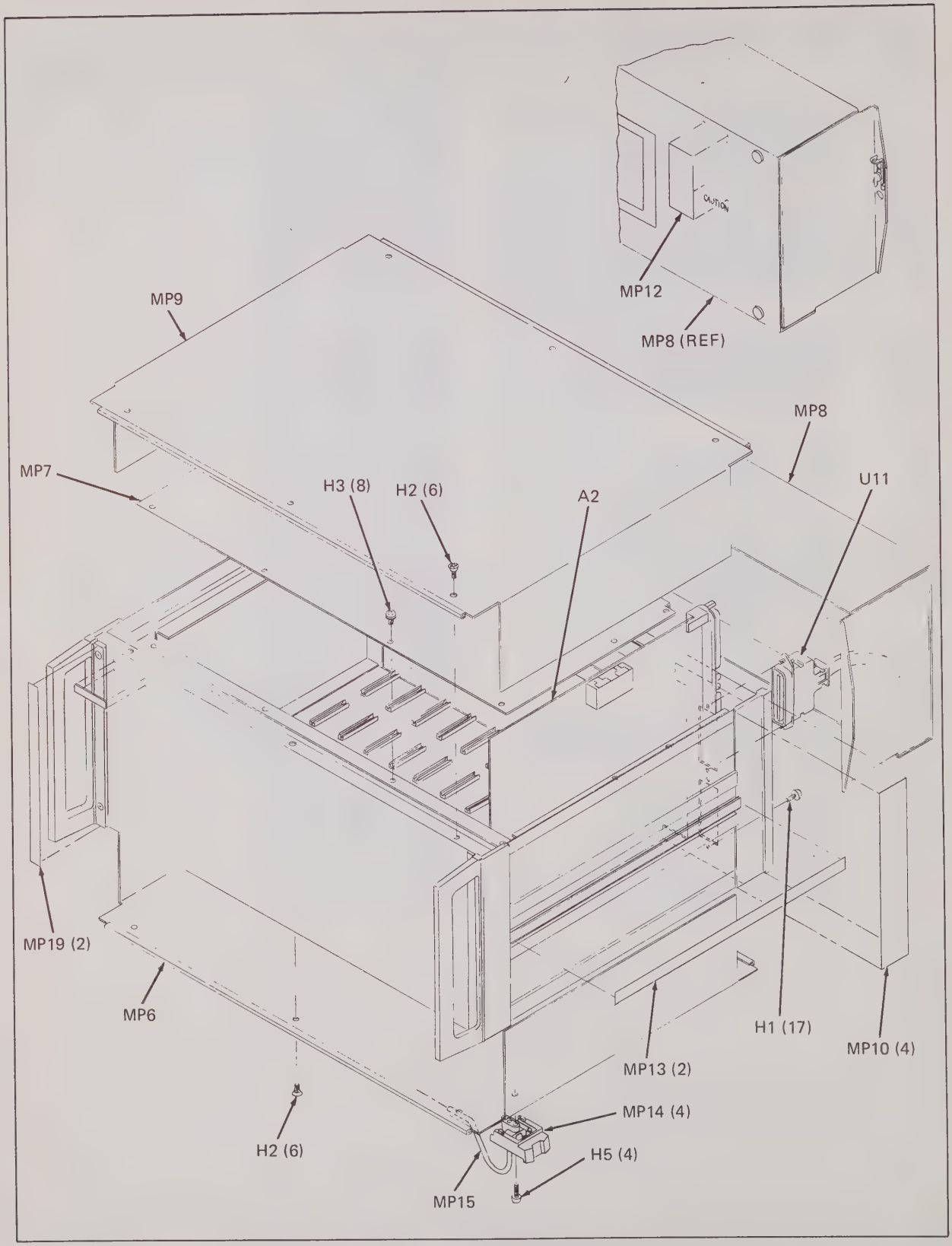



**Figure 5-1. 2201A Scanner Chassis Final Assembly**

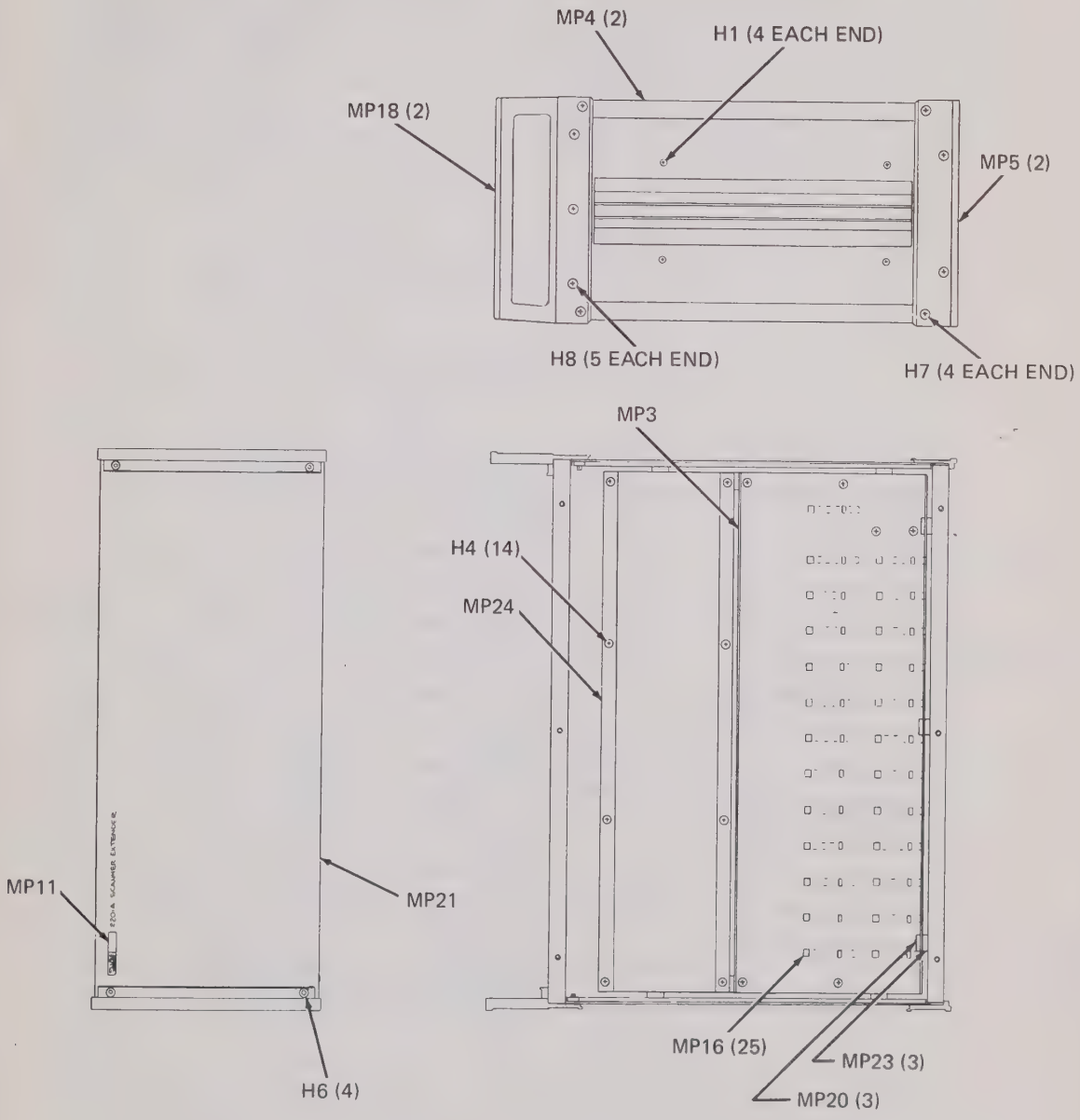



**Figure 5-1. 2201A Scanner Chassis Final Assembly (cont)**

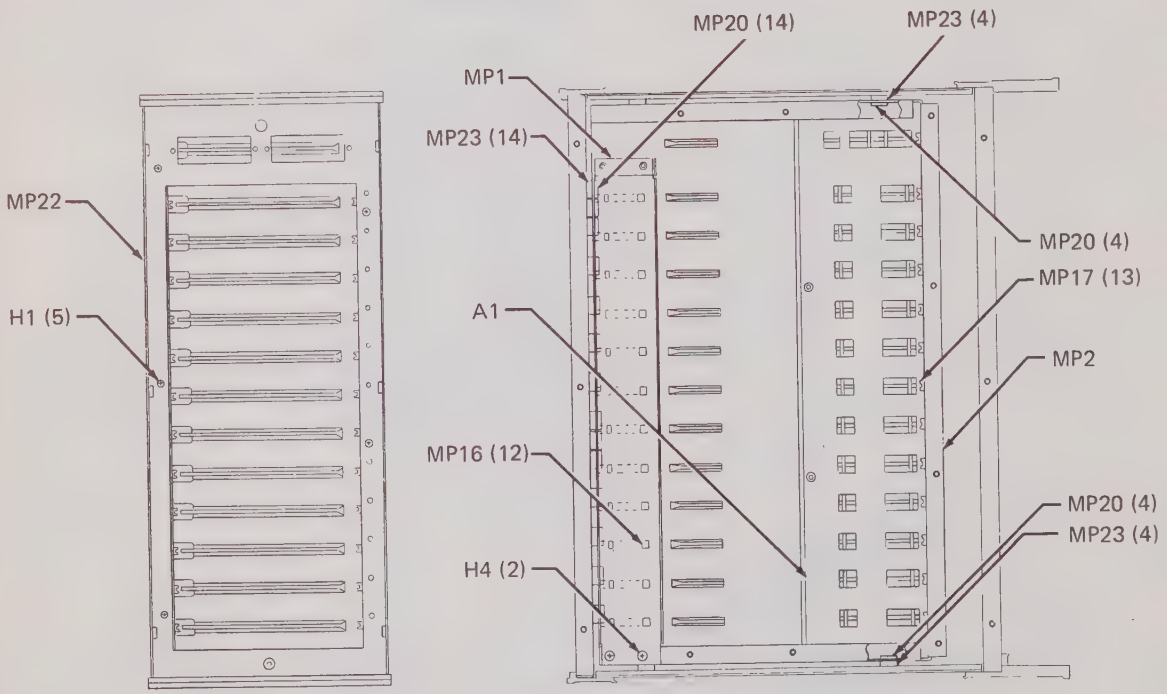



**Figure 5-1. 2201A Scanner Chassis Final Assembly (cont)**

Table 5-2. A1 Mother Board PCB Assembly

| ITEM NO. | DESCRIPTION | FLUKE STOCK NO. | MFG SPLY CODE | MFG PART NO. OR TYPE | TOT QTY | REC QTY | USE CDE |
|---|---|---|---|---|---|---|---|
| A1 | MOTHER BOARD PCB ASSEMBLY FIGURE 5-2 (2201A-4001) | 419465 | 89536 | 419465 | REF | | |
| J1 | CONNECTOR, CARD EDGE | 291625 | 00779 | 583650-1 | 13 | | |
| J2 | CONNECTOR, CARD EDGE | 295352 | 00779 | 583650-9 | 1 | | |
| J11 | CONNECTOR, CARD EDGE | 291898 | 00779 | 583650-2 | 12 | | |
| J12 | CONNECTOR, CARD EDGE | 291625 | 00779 | 583650-1 | REF | | |
| MP1 | INSERT, POLARIZING (NOT SHOWN) (W/J2, J11, J12) | 424572 | 00779 | 530286-2 | 26 | | |

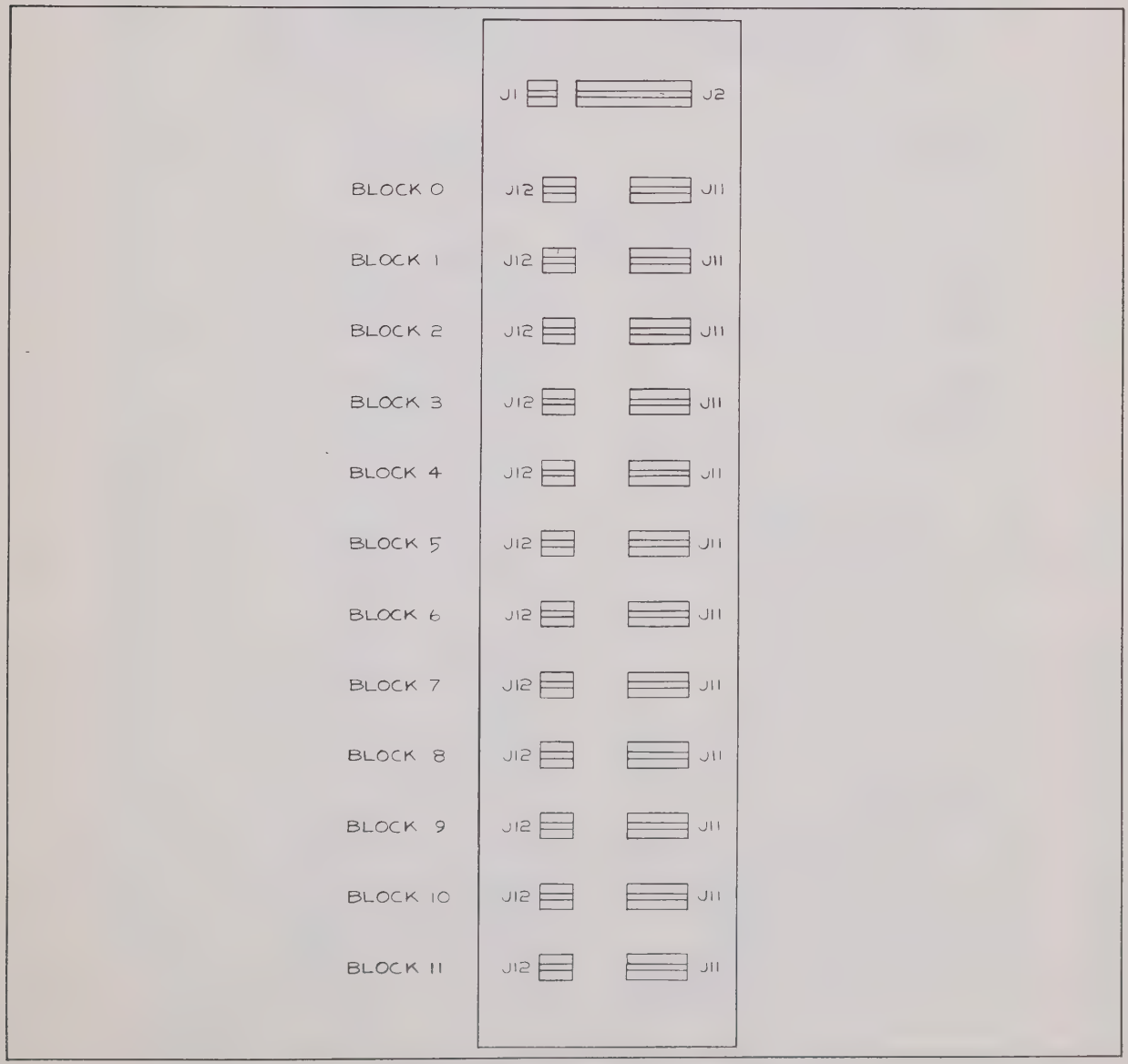



Figure 5-2. A1 Mother Board PCB Assembly

Table 5-3. A2 Bank Select PCB Assembly

| ITEM NO. | DESCRIPTION | FLUKE STOCK NO. | MFG SPLY CODE | MFG PART NO. OR TYPE | TOT QTY | REC QTY | USE CDE |
|---|---|---|---|---|---|---|---|
| A2 | Ⓐ BANK SELECT PCB ASSEMBLY FIGURE 5-3 (2201A-4002T) | 419622 | 89536 | 419622 | REF | | |
| C1 | CAP, CER, 0.025 UF +/-20%, 50V | 168435 | 56289 | C023B101H253M | 12 | | |
| C2 | CAP, CER, 0.025 UF +/-20%, 50V | 168435 | 56289 | C023B101H253M | REF | | |
| C3 | CAP, CER, 0.025 UF +/-20%, 50V | 168435 | 56289 | C023B101H253M | REF | | |
| C4 | CAP, CER, 0.025 UF +/-20%, 50V | 168435 | 56289 | C023B101H253M | REF | | |
| C5 | CAP, CER, 0.025 UF +/-20%, 50V | 168435 | 56289 | C023B101H253M | REF | | |
| C6 | CAP, CER, 0.025 UF +/-20%, 50V | 168435 | 56289 | C023B101H253M | REF | | |
| C7 | CAP, CER, 0.025 UF +/-20%, 50V | 168435 | 56289 | C023B101H253M | REF | | |
| C8 | CAP, CER, 0.025 UF +/-20%, 50V | 168435 | 56289 | C023B101H253M | REF | | |
| C9 | CAP, CER, 0.025 UF +/-20%, 50V | 168435 | 56289 | C023B101H253M | REF | | |
| C10 | CAP, CER, 0.025 UF +/-20%, 50V | 168435 | 56289 | C023B101H253M | REF | | |
| C11 | CAP, CER, 0.025 UF +/-20%, 50V | 168435 | 56289 | C023B101H253M | REF | | |
| C12 | CAP, CER, 0.025 UF +/-20%, 50V | 168435 | 56289 | C023B101H253M | REF | | |
| C13 | CAP, TA, 10 UF, 20V | 330662 | 56289 | 196D106X0020KA1 | 1 | | |
| CR1 | DIODE, SI, HI-SPEED SWITCHING | 203323 | 07910 | 1N4448 | 1 | 1 | |
| H1 | LUG, SOLDER (NOT SHOWN) | 151431 | 79963 | 329 | 2 | | |
| H2 | SCREW, PHP, 4-40 X 3/8 | 152124 | 89536 | 152124 | 4 | | |
| H3 | WASHER, SPLIT/LK #4 (NOT SHOWN) | 110395 | 73734 | 1355 | 4 | | |
| H4 | NUT, 4-40 (NOT SHOWN) | 147611 | 89536 | 147611 | 4 | | |
| J3 | CONNECTOR, BD. EDGE | 414409 | 00779 | 552241-1 | 2 | | |
| J4 | CONNECTOR, BD. EDGE | 414409 | 00779 | 552241-1 | REF | | |
| K1 | COIL, REED RELAY | 272070 | 71707 | UD6P | 1 | | |
| L1 | CHOKE, FERRITE | 320911 | 89536 | 320911 | 1 | | |
| MP1 | CONNECTOR, HDW. KIT (NOT SHOWN) | 448563 | 89536 | 448563 | 2 | | |
| MP2 | HOLDER, COMPONENT | 104794 | 98159 | 2829-115-3 | 1 | | |
| Q1 | XSTR, PNP, SI | 218396 | 04713 | 2N3904 | 1 | 1 | |
| R1 | RES, COMP, 3.3K +/-5%, 1/4W | 148056 | 01121 | CB3325 | 1 | | |
| R2 | RES, COMP, 100K +/-5%, 1/4W | 148189 | 01121 | CB1045 | 12 | | |
| R3 | RES, COMP, 100K +/-5%, 1/4W | 148189 | 01121 | CB1045 | REF | | |
| R4 | RES, COMP, 100K +/-5%, 1/4W | 148189 | 01121 | CB1045 | REF | | |
| R5 | RES, COMP, 100K +/-5%, 1/4W | 148189 | 01121 | CB1045 | REF | | |
| R6 | RES, COMP, 100K +/-5%, 1/4W | 148189 | 01121 | CB1045 | REF | | |
| R7 | RES, COMP, 100K +/-5%, 1/4W | 148189 | 01121 | CB1045 | REF | | |
| R8 | RES, COMP, 100K +/-5%, 1/4W | 148189 | 01121 | CB1045 | REF | | |
| R9 | RES, COMP, 100K +/-5%, 1/4W | 148189 | 01121 | CB1045 | REF | | |
| R10 | RES, COMP, 100K +/-5%, 1/4W | 148189 | 01121 | CB1045 | REF | | |
| R11 | RES, COMP, 100K +/-5%, 1/4W | 148189 | 01121 | CB1045 | REF | | |
| R12 | RES, COMP, 100K +/-5%, 1/4W | 148189 | 01121 | CB1045 | REF | | |
| R13 | RES, COMP, 100K +/-5%, 1/4W | 148189 | 01121 | CB1045 | REF | | |
| S1 | SWITCH, THUMB-WHEEL | 422972 | 89536 | 422972 | 1 | 1 | |
| S2 | SWITCH, REED | 414300 | 95348 | 414300 | 2 | 1 | |
| S3 | SWITCH, REED | 414300 | 95348 | 414300 | REF | | |
| U1 | Ⓐ IC, C-MOS, NAND GATES | 355198 | 04713 | MC14011CP | 1 | 1 | |
| U2 | Ⓐ IC, COS/MOS, GATES, NAND/NOR BUFF | 355172 | 04713 | MC14001CP | 1 | 1 | |
| U3 | Ⓐ IC, C-MOS, NATURAL BCD ADDER | 418376 | 04713 | MC14560CP | 2 | 1 | |
| U4 | Ⓐ IC, C-MOS, NATURAL BCD ADDER | 418376 | 04713 | MC14560CP | REF | | |
| U5 | Ⓐ IC, C-MOS, HEX, BUFF/INVTR | 381830 | 86684 | CD4050AE | 3 | 1 | |
| U6 | Ⓐ IC, C-MOS, NOR GATES | 363820 | 04713 | MC14002CP | 3 | 1 | |
| U7 | Ⓐ IC, C-MOS, BCD-TO-DECIMAL DECODER | 380741 | 86684 | CD4028AE | 1 | 1 | |

Table 5-3. A2 Bank Select PCB Assembly (cont)

| ITEM NO. | DESCRIPTION | FLUKE STOCK NO. | MFG SPLY CODE | MFG PART NO. OR TYPE | TOT QTY | REC QTY | USE CDE |
|---|---|---|---|---|---|---|---|
| U8 | Ⓐ IC, C-MOS, NOR GATES | 363820 | 04713 | MC14002CP | REF | | |
| U9 | Ⓐ IC, C-MOS, HES, BUFF/INVTR | 381848 | 86684 | CD4049AE | 1 | 1 | |
| U10 | NEWTORK, RES, 100K +/-5%, 10V | 380618 | 89536 | 380618 | 1 | 1 | |
| U11 | Ⓐ IC, C-MOS, NOR GATES | 363820 | 04713 | MC14002CP | REF | | |
| U12 | Ⓐ IC, C-MOS, HEX, BUFF/INVTR | 381830 | 86684 | CD4050AE | REF | | |
| U13 | Ⓐ IC, C-MOS, HEX, BUFF/INVTR | 381830 | 86684 | CD4050AE | REF | | |

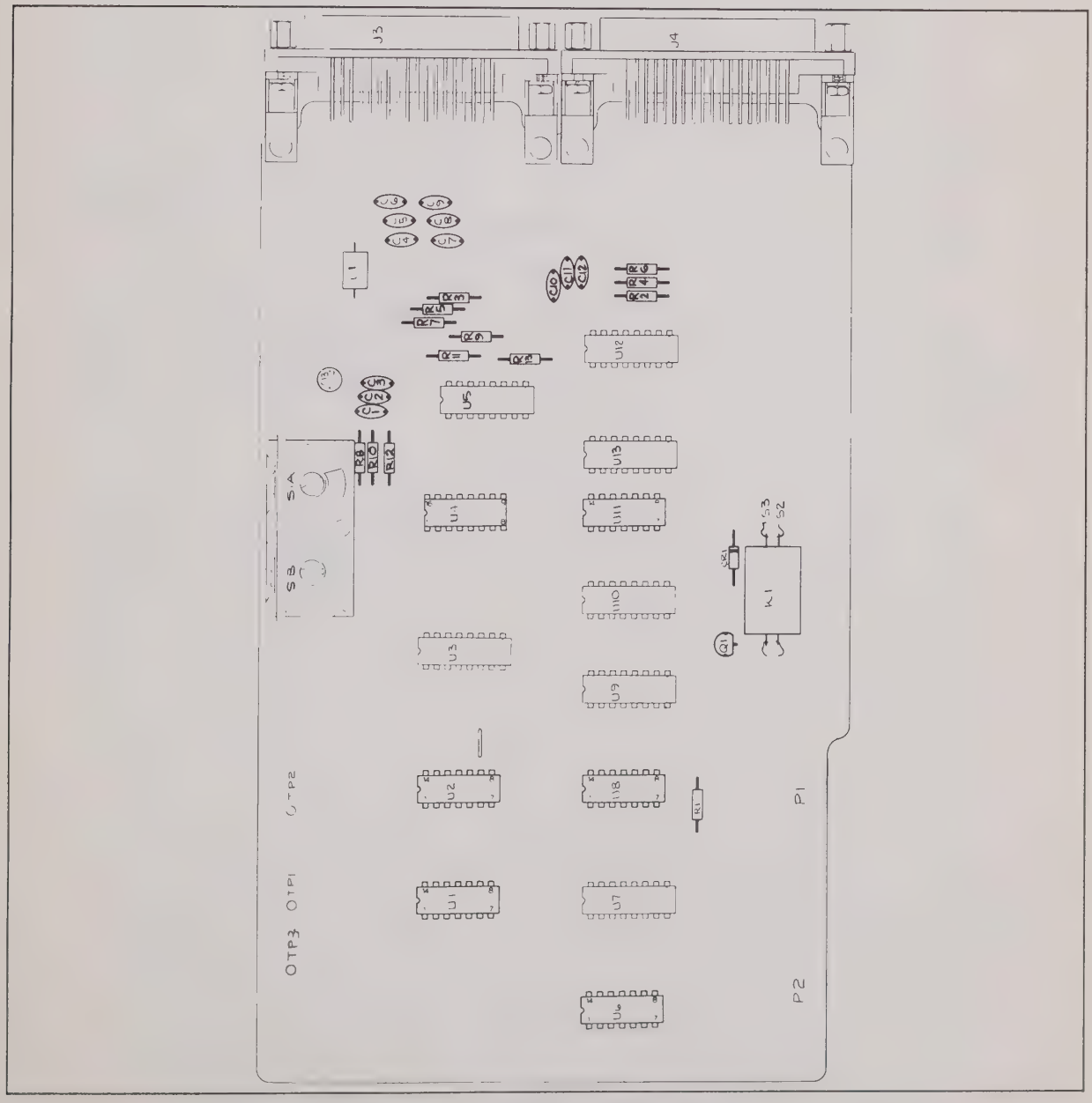



Figure 5-3. A2 Bank Select PCB Assembly

# Section 6
# Option & Accessory Information

## TABLE OF CONTENTS


| OPTION/ MODEL NO. | DESCRIPTION | PAGE |
|---|---|---|
| | OPTIONS | |
| -05 | General Purpose Scanner | 6-2 |
| -06 | Low Level Scanner | 6-2 |
| -07 | Solder Pin Connector | 6-2 |
| -08 | Isothermal Connector | 6-2 |
| | ACCESSORIES | |
| 2200A-7001 | Connector and Assembly, Remote Scanner Cable | 6-2 |
| 2200A-7002 | Remote Scanner Chassis Cable | 6-2 |
| M07-205-600 | Rack Mounting Kit | 6-2 |
| M00-280-610 | Rack Slide Kit | 6-3 |

## 6-1. INTRODUCTION

6-2. This section of the manual contains information concerning Options and Accessories available for use with the Model 2201A Scanner Chassis. Information is included on the following Options and Accessories:

| | OPTIONS |
|---|---|
| 2200A-05 | General Purpose Scanner |
| 2200A-06 | Low Level Scanner |
| 2200A-07 | Solder Pin Connector |
| 2200A-08 | Isothermal Connector |
| | ACCESSORIES |
| 2200A-7001 | Connector and Assembly, Remote Scanner Cable |
| 2200A-7002 | Remote Scanner Chassis Cable |
| M07-205-600 | Rack Mounting Kit |
| M00-280-610 | Rack Slide Kit |

## 6-3. OPTIONS

### 6-4. General Purpose Scanner (Option -05)

6-5. A 10-channel General Purpose Scanner, designed for general purpose multiplexing applications, is available for use with the 2201A. One or more General Purpose Scanners may be installed together with Low Level Scanner (Option -06) in a single 2201A. Refer to Section 6 of the data logger manual for a complete description of the General Purpose Scanner.

### 6-6. Low Level Scanner (Option -06)

6-7. A 10-channel Low Level Scanner, designed for low-level multiplexing applications is available for use in the 2201A. One or more Low Level Scanners may be installed together with General Purpose Scanners (Option -05) in a single 2201A. Refer to Section 6 of the data logger manual for a complete desciption of the Low Level Scanner.

### 6-8. Solder Pin Connector (Option -07)

6-9. The Solder Pin Connector is a 30-pin, 10-channel card-edge with provisions for soldering inputs directly to the connector pins. The Solder Pin Connector is recommended for general purpose dc voltage measurements. Refer to Section 6 of the data logger manual for a complete description of the Solder Pin Connector.

### 6-10. Isothermal Connector (Option -08)

6-11. The Isothermal Connector is a 30-pin, 10-channel card-edge connector designed for use in making thermocouple temperature measurements and/or dc voltage measurements. Input connections are in the form of convenient screw-type terminals refer to Section 6 of the data logger manual for a complete description of the isothermal connector.

## 6-12. ACCESSORIES

### 6-13. Connector and Assembly, Remote Scanner Cable (2200A-7001)

6-14. This connector and assembly is part of the cable required to locate the 2201A remotely from the data logger.

### 6-15. Remote Scanner Chassis Cable (2200A-7002)

6-16. This cable is required for completion of the Connector and Assembly (2200A-7001) in applications where the 2201A is to be located remotely (up to 50 ft.) from the data logger. The desired length must be specified when ordering.

### 6-17. Rack Mounting Kit (M07-205-600)

6-18. The 2201A can be rack mounted in a standard 19-inch equipment rack using Rack Mounting Kit M07-205-600. Use the following procedure to install the kit:

1. Peel off the name plate decals from the front side corner of the 2201A.

2. Remove the front corner screws which match the hole pattern in the rack mounting ears (see Figure 6-1).

3. Attach the rack mounting ears to the front corners of the unit using the screws supplied in the rack mounting kit.

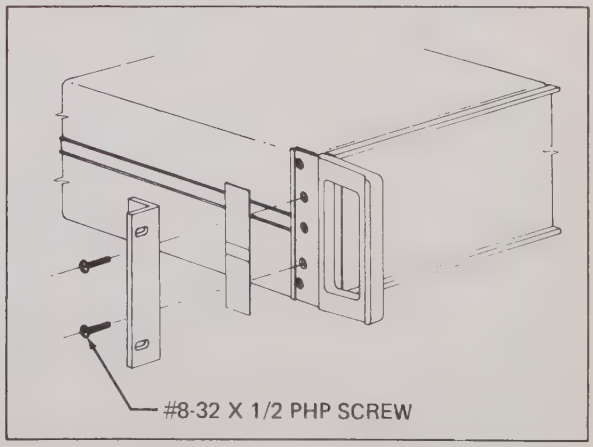



Figure 6-1. Rack Mounting Kit

## 6-19. Rack Slide Kit (M00-280-610)

6-20. The 2201A can be rack-mounted in a 24-inch deep equipment rack using the Rack Slide Kit M00-280-610. Use the following procedure to install the kit:

1. Remove the horizontal side trim decal from both sides of the 2201A.

2. Refer to Figure 6-2 and, using the screws supplied with the kit, attach the Chassis Section (B) of the slide kit to each side of the unit. Use the center row of mounting holes.

3. Install the Cabinet Section (D) and the Center Section (C) in the equipment rack.

4. Pull the Center Section of the slide out through the front of the equipment rack until it locks in the extended position.

5. Depress the spring locks on the Chassis Section (B) and join Section B and C.

6. Push the instrument into the equipment rack and then pull it out to the extended position. The spring locks should limit the rack slide travel.

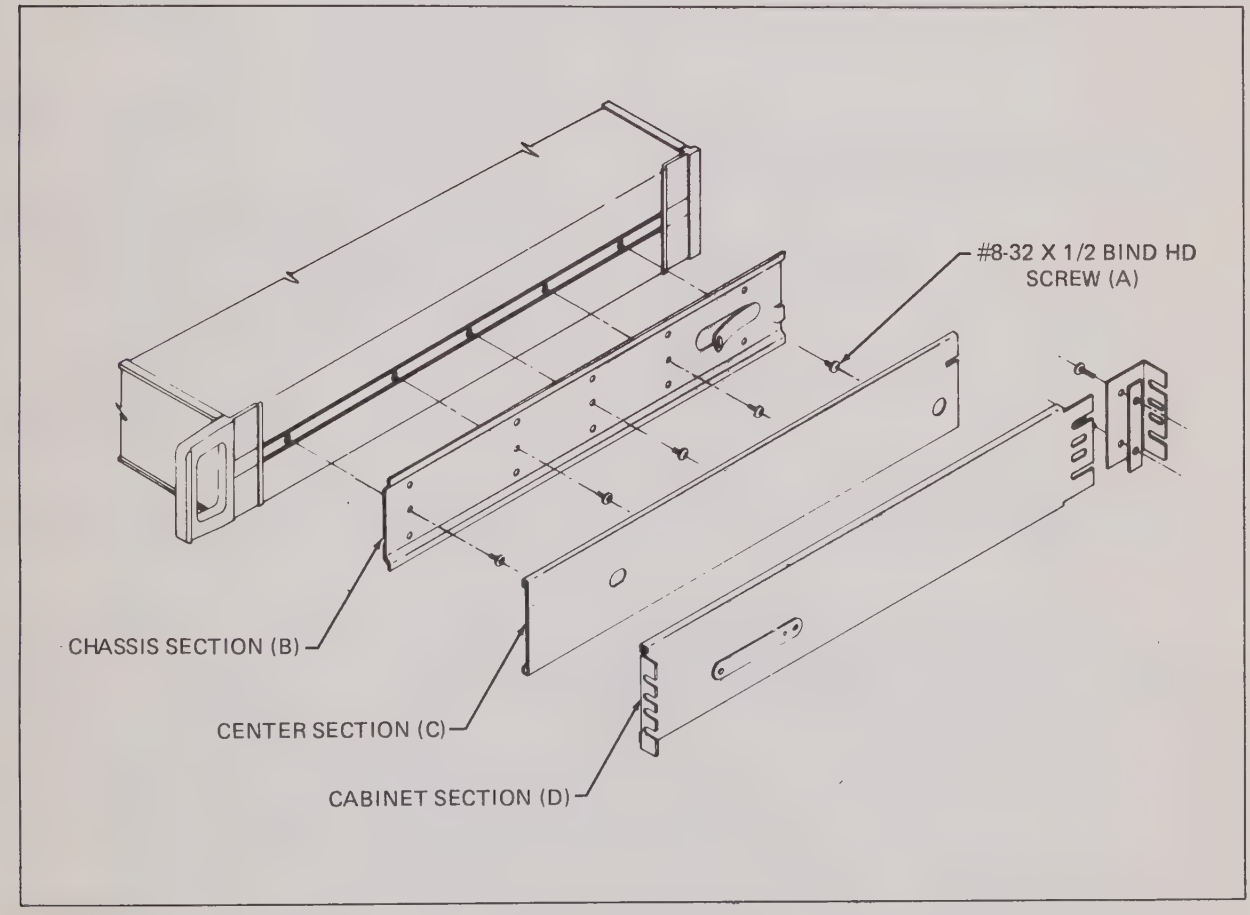



Figure 6-2. Rack Slide Kit

# Appendix 7A
# Manual Change Information

## INTRODUCTION

This appendix contains information necessary to backdate the manual to conform with earlier pcb configurations. To identify the configuration of the pcb's used in your instrument, refer to the revision letter (marked in ink) on the component side of each pcb assembly. Table 7A-1 defines the assembly revision levels documented in this manual.

## NEWER INSTRUMENTS

As changes and improvements are made to the instrument, they are identified by incrementing the revision letter marked on the affected pcb assembly. These changes are documented on a supplemental change/errata sheet which, when applicable, is inserted at the front of the manual.

## OLDER INSTRUMENTS

To backdate this manual to conform with earlier assembly revision levels, perform the changes indicated in Table 7A-1.

## CHANGES

There are no backdating changes at this printing. All pcb assemblies are documented at their original revision level.

**Table 7A-1. Manual Status and Backdating Information**

| Ref Or Option No. | Assembly Name | Fluke Part No. | * To adapt manual to earlier rev configurations perform changes in desending order (by no.), ending with change under desired rev letter | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | — | A | B | C | D | E | F | G | H | J | K | L | M | N | P | | | | | | | | | |
| A1 | Mother Board PCB Assembly | 419465 | ● | 1 | X | | | | | | | | | | | | | | | | | | | | |
| A2 | Bank Select PCB Assembly | 419622 | ● | ● | ● | ● | ● | ● | ● | 2 | X | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | |

* X = The PCB revision levels documented in this manual.
● = These revision letters were never used in the instrument.
—= No revision letter on the PCB.

CHANGE #1, ECO –11671

Documentation change, does not affect manual.

CHANGE #2, ECO –11765

Documentation change, does not affect manual.

## Section 7

# General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable parts contained in Section 5. The following information is presented in this section:

List of Abbreviations

Federal Supply Codes for Manufacturers

Fluke Technical Service Centers — U.S. and Canada

Sales and Service Locations — International

Sales Representatives — U.S. and Canada

| | |
|---|---|
| A or amp | ampere |
| ac | alternating current |
| af | audio frequency |
| a/d | analog-to-digital |
| assy | assembly |
| AWG | american wire gauge |
| B | bel |
| bcd | binary coded decimal |
| $^{o}C$ | Celsius |
| cap | capacitor |
| ccw | counterclockwise |
| cer | ceramic |
| cermet | ceramic to metal(seal) |
| ckt | circuit |
| cm | centimeter |
| cmrr | common mode rejection ratio |
| comp | composition |
| cont | continue |
| crt | cathode-ray tube |
| cw | clockwise |
| d/a | digital-to-analog |
| dac | digital-to-analog converter |
| dB | decibel |
| dc | direct current |
| dmm | digital multimeter |
| dvm | digital voltmeter |
| elect | electrolytic |
| ext | external |
| F | farad |
| $^{o}F$ | Fahrenheit |
| FET | Field-effect transistor |
| ff | flip-flop |
| freq | frequency |
| FSN | federal stock number |
| g | gram |
| G | giga ($10^{9}$) |
| gd | guard |
| Ge | germanium |
| GHz | gigahertz |
| gmv | guaranteed minimum value |
| gnd | ground |
| H | henry |
| hd | heavy duty |
| hf | high frequency |
| Hz | hertz |
| IC | integrated circuit |
| if | intermediate frequency |
| in | inch(es) |
| intl | internal |
| I/O | input/output |
| k | kilo ($10^{3}$) |
| kHz | kilohertz |
| k$\Omega$ | kilohm(s) |
| kV | kilovolt(s) |
| lf | low frequency |
| LED | light-emitting diode |
| LSB | least significant bit |
| LSD | least significant digit |
| M | mega ($10^{6}$) |
| m | milli ($10^{-3}$) |
| mA | milliampere(s) |
| max | maximum |
| mf | metal film |
| MHz | megahertz |
| min | minimum |
| mm | millimeter |
| ms | millisecond |
| MSB | most significant bit |
| MSD | most significant digit |
| MTBF | mean time between failures |
| MTTR | mean time to repair |
| mV | millivolt(s) |
| mv | multivibrator |
| M$\Omega$ | megohm(s) |
| n | nano ($10^{-9}$) |
| na | not applicable |
| NC | normally closed |
| (–) or neg | negative |
| NO | normally open |
| ns | nanosecond |
| opnl ampl | operational amplifier |
| p | pico ($10^{-12}$) |
| para | paragraph |
| pcb | printed circuit board |
| pF | picofarad |
| pn | part number |
| (+) or pos | positive |
| pot | potentiometer |
| p-p | peak-to-peak |
| ppm | parts per million |
| PROM | programmable read-only memory |
| psi | pound-force per square inch |
| RAM | random-access memory |
| rf | radio frequency |
| rms | root mean square |
| ROM | read-only memory |
| s or sec | second (time) |
| scope | oscilloscope |
| SH | shield |
| Si | silicon |
| serno | serial number |
| sr | shift register |
| Ta | tantalum |
| tb | terminal board |
| tc | temperature coefficient or temperature compensating |
| tcxo | temperature compensated crystal oscillator |
| tp | test point |
| u or $\mu$ | micro ($10^{-6}$) |
| uhf | ultra high frequency |
| us or $\mu$s | microsecond(s) ($10^{-6}$) |
| uut | unit under test |
| V | volt |
| v | voltage |
| var | variable |
| vco | voltage controlled oscillator |
| vhf | very high frequency |
| vlf | very low frequency |
| W | watt(s) |
| ww | wire wound |
| xfmr | transformer |
| xstr | transistor |
| xtal | crystal |
| xtlo | crystal oscillator |
| $\Omega$ | ohm(s) |
| $\mu$ | micro ($10^{-6}$) |

## Federal Supply Codes for Manufacturers (Continued)

00213
Nytronics Comp. Group Inc.
Subsidiary of Nytronics Inc.
Formerly Sage Electronics
Rochester, New York

00327
Welwyn International, Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors, Inc.
Passaic, New Jersey

00779
AMP Inc.
Harrisberg, Pennsylvania

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronic Comp.
Semiconductor Operations
Lawndale, California

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics Inc.
Manchester, New Hampshire

01730
Replaced by 73586

01884 - use 56289
Sprague Electric Co.
Dearborn Electronic Div.
Lockwood, Florida

02114
Ferroxcube Corp.
Saugerties, New York

02131
General Instrument Corp.
Harris ASW Div.
Westwood, Maine

02395
Rason Mfg. Co.
Brooklyn, New York

02533
Snelgrove, C.R. Co., Ltd.
Don Mills, Ontario, Canada
M3B 1M2

02606
Fenwal Labs
Div. of Travenal Labs.
Morton Grove, Illinois

02660
Bunker Ramo Corp., Conn Div.
Formerly Amphenol-Borg
Electric Corp.
Broadview, Illinois

02799
Areo Capacitors, Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products
Syracuse, New York

03614
Replaced by 71400

03651
Replaced by 44655

03797
Eldema Div.
Genisco Technology Corp.
Compton, California

03877
Transistron Electronic Corp.
Wakefield, Massachusetts

03888
KDI Pyrofilm Corp.
Whippany, New Jersey

03911
Clairex Electronics Div.
Clairex Corp.
Mt. Vernon, New York

03980
Muirhead Inc.
Mountainside, New Jersey

04009
Arrow Hart Inc.
Hartford, Connecticut

04062
Replaced by 72136

04202
Replaced by 81312

04217
Essex International Inc.
Wire & Cable Div.
Anaheim, California

04221
Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222
AVX Ceramics Div.
AVX Corp.
Myrtle Beach, Florida

04423
Telonic Industries
Laguna Beach, California

04645
Replaced by 75376

04713
Motorola Inc. Semiconductor
Products
Phoenix, Arizona

04946
Standard Wire & Cable
Los Angeles, California

05082
Replaced by 94988

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Components Corp. now
Corcom, Inc.
Chicago, Illinois

05277
Westinghouse Electric Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05278
Replaced by 43543

05279
Southwest Machine &
Plastic Co.
Glendora, California

05397
Union Carbide Corp.
Materials Systems Div.
New York, New York

05571 - use 56289
Sprague Electric Co.
Pacific Div.
Los Angeles, California

05574
Viking Industries
Chatsworth, California

05704
Replaced by 16258

05820
Wakefield Engineering Inc.
Wakefield, Massachusetts

06001
General Electric Co.
Electronic Capacitor &
Battery Products Dept.
Columbia, South Carolina

06136
Replaced by 63743

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol SAMS Div.
Chatsworth, California

06555
Beede Electrical Instrument Co.
Penacook, New Hampshire

06739
Electron Corp.
Littleton, Colorado

06743
Clevite Corp.
Cleveland, Ohio

06751
Components, Inc. Semcor Div.
Phoenix, Arizona

06860
Gould Automotive Div.
City of Industry, California

06961
Vernitron Corp., Piezo
Electric Div.
Formerly Clevite Corp., Piezo
Electric Div.
Bedford, Ohio

06980
Eimac Div.
Varian Associates
San Carlos, California

07047
Ross Milton, Co., The
South Hampton, Pennsylvania

07115
Replaced by 14674

07138
Westinghouse Electric Corp.,
Electronic Tube Division
Horsehead, New York

07233
TRW Electronic Components
Cinch Graphic
City of Industry, California

07256
Silicon Transistor Corp.
Div. of BBF Group Inc.
Chelmsford, MA

07261
Aumet Corp.
Culver City, California

07263
Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344
Bircher Co., Inc.
Rochester, New York

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07910
Teledyne Semiconductor
Formerly Continental Device
Hawthorne, California

07933 - use 49956
Raytheon Co.
Semiconductor Div. HQ
Mountain View, California

08225
Industro Transistor Corp.
Long Island City, New York

08261
Spectra Strip Corp.
Garden Grove, California

08530
Reliance Mica Corp.
Brooklyn, New York

08806
General Electric Co.
Miniature Lamp Products Dept.
Cleveland, Ohio

08863
Nylomatic Corp.
Norrisville, Pennsylvania

08988 - use 53085
Skottie Electronics Inc.
Archbald, Pennsylvania

09214
G.E. Co. Semi-Conductor
Products Dept.
Power Semi-Conductor
Products OPN Sec.
Auburn, New York

09353
C and K Components
Watertown, Massachusetts

09423
Scientific Components, Inc.
Santa Barbara, California

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, S. Dakota

10059
Barker Engineering Corp.
Formerly Amerace, Amerace
ESNA Corp.
Kenilworth, New Jersey

11236
CTS of Berne
Berne, Indiana

11237
CTS Keene Inc.
Paso Robles, California

11358
CBS Electronic Div.
Columbia Broadcasting System
Newburyport, MN

11403
Best Products Co.
Chicago, Illinois

11503
Keystone Columbia Inc.
Warren, Michigan

11532
Teledyne Relays
Hawthorne, California

## Federal Supply Codes for Manufacturers (Continued)

11711
General Instrument Corp
Rectifier Division
Hickville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Bellwood, Illinois

12040
National Semiconductor Corp.
Danburry, Connecticut

12060
Diodes, Inc.
Chatsworth, California

12136
Philadelphia Handle Co.
Camden, New Jersey

12300
Potter-Brumfield Division
AMF Canada LTD.
Guelph, Onatrio, Canada

12323
Presin Co., Inc.
Shelton, Connecticut

12327
Freeway Corp. formerly
Freeway Washer & Stamping Co.
Cleveland, Ohio

12443
Budd Co. The, Polychem Products
Plastic Products Div.
Bridgeport, PA

12615
U.S. Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co.
Dover, New Hampshire

12749
James Electronics
Chicago, Illinois

12856
Micrometals
Sierra Madre, California

12954
Dickson Electronics Corp.
Scottsdale, Arizona

12969
Unitrode Corp.
Watertown, Massachusetts

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Amphenol Cadre Div.
Bunker-Ramo Corp.
Los Gatos, California

13606 - use 56289
Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839
Replaced by 23732

14099
Semtech Corp.
Newbury Park, California

14140
Edison Electronic Div.
Mc Gray-Edison Co.
Manchester, New Hampshire

14193
Cal-R-Inc. formerly
California Resistor, Corp.
Santa Monica, California

14298
American Components, Inc.
an Insilco Co.
Conshohocken, Pennsylvania

14655
Cornell-Dublier Electronics
Division of Federal Pacific
Electric Co. Govt. Control Dept.
Newark, New Jersey

14752
Electro Cube Inc.
San Gabriel, California

14869
Replaced by 96853

14936
General Instrument Corp.
Semi Conductor Products Group
Hicksville, New York

15636
Elec-Trol Inc.
Saugus, California

15801
Fenwal Electronics Inc.
Div. of Kidde Walter and Co., Inc.
Framingham, Massachusetts

15818
Teledyne Semiconductors, formerly
Amelco Semiconductor
Mountain View, California

15849
Litton Systems Inc. Useco Div.
formerly Useco Inc.
Van Nuys, California

15898
International Business
Machines Corp.
Essex Junction, Vermont

15909
Replaced by 14140

16258
Space-Lok Inc.
Burbank, California

16299
Corning Glass
Electronic Components Div.
Raleigh, North Carolina

16332
Replaced by 28478

16473
Cambridge Scientific Ind.
Div. of Chemed Corporation
Cambridge, Maryland

16742
Paramount Plastics Fabricators, Inc.
Downey, California

16758
Delco Electronics
Div. of General Motors Corp.
Kokomo, Indiana

17001
Replaced by 71468

17069
Circuit Structures Lab.
Burbank, California

17338
High Pressure Eng. Co., Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors, Inc.
Asbury Park, New Jersey

17856
Siliconix, Inc.
Santa Clara, California

17870
Replaced by 14140

18178
Vactec Inc.
Maryland Heights, Missouri

18324
Signetics Corp.
Sunnyvale, California

18612
Vishay Resistor Products Div.
Vishay Intertechnology Inc.
Malvern, Pennsylvania

18736
Voltronics Corp.
Hanover, New Jersey

18927
G T E Sylvania Inc.
Precision Material Group
Parts Division
Titusville, Pennsylvania

19451
Perine Machinery & Supply Co.
Seattle, Washington

19701
Electro-Midland Corp.
Mepco-Electra Inc.
Mineral Wells, Texas

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

20891
Self-Organizing Systems, Inc.
Dallas, Texas

21604
Buckeye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Transistor Division
Riveria Beach, Florida

22767
ITT Semiconductors
Palo Alto, California

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Inc.
Rockville, Maryland

23880
Stanford Applied Engrng.
Santa Clara, California

23936
Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248
Replaced by 94222

24355
Analog Devices Inc.
Norwood, Massachusetts

24655
General Radio
Concord, Massachusetts

24759
Lenox-Fugle Electronics Inc.
South Plainfield, New Jersey

25088
Siemen Corp.
Isilen, New Jersey

25403
Amperex Electronic Corp.
Semiconductor &
Micro-Circuits Div.
Slatersville, Rhode Island

27014
National Semiconductor Corp.
Santa Clara, California

27264
Molex Products
Downers Grove, Illinois

28213
Minnesota Mining & Mfg. Co.
Consumer Products Div.
St. Paul, Minnesota

28425
Serv-/-Link formerly
Bohannan Industries
Fort Worth, Texas

28478
Deltrol Controls Div.
Deltrol Corporation
Milwaukee, Wisconsin

28480
Hewlett Packard Co. Corporate H.Q.
Palo Alto, California

28520
Heyman Mfg. Co.
Kenilworth, New Jersey

29083
Monsanto, Co., Inc.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

30148
A B Enterprise Inc.
Ahoskie, North Carolina

30323
Illinois Tool Works, Inc.
Chicago, Illinois

31091
Optimax Inc.
Colmar, Pennsylvania

32539
Mura Corp.
Great Neck, New York

32767
Griffith Plastic Corp.
Burlingame, California

32879
Advanced Mechanical Components
Northridge, California

32897
Erie Technological Products, Inc.
Frequency Control Div.
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Products Division
Riverside, California

33173
General Electric Co.
Products Dept.
Owensboro, Kentucky

34333
Silicon General
Westminister, California

34335
Advanced Micro Devices
Sunnyvale, California

34802
Electromotive Inc.
Kenilworth, New Jersey

37942
Mallory, P.R. & Co., Inc.
Indianapolis, Indiana

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.
Transformer Co. Div.
Geneva, New York

44655
Ohmite Mfg. Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

49956
Raytheon Company
Lexington, Massachusetts

50088
Mostek Corp.
Carrollton, Texas

50579
Litronix Inc.
Cupertino, California

51605
Scientific Components Inc.
Linden, New Jersey

53021
Sangamo Electric Co.
Springfield, Illinois

54294
Cutler-Hammer Inc. formerly
Shallcross, A Cutter-Hammer Co.
Selma, North Carolina

55026
Simpson Electric Co.
Div. of Am. Gage and Mach. Co.
Elgin, Illinois

56289
Sprague Electric Co.
North Adams, Massachusetts

58474
Superior Electric Co.
Bristol, Connecticut

60399
Torin Corp, formerly
Torrington Mfg. Co.
Torrington, Connecticut

63743
Ward Leonard Electric Co., Inc.
Mount Vernon, New York

64834
West Mfg. Co.
San Francisco, Californai

65092
Weston Instruments Inc.
Newark, New Jersey

66150
Winslow Tele-Tronics Inc.
Eaton Town, New Jersey

70485
Atlantic India Rubber Works
Chicago, Illinois

70563
Amperite Company
Union City, New Jersey

70903
Belden Corp.
Geneva, Illinois

71002
Birnbach Radio Co., Inc.
Freeport, LI New York

71400
Bussmann Mfg.
Div. of McGraw-Edison Co.
Saint Louis, Missouri

71450
CTS Corp.
Elkhart, Indiana

71468
ITT Cannon Electric Inc.
Santa Ana, California

71482
Clare, C.P. & Co.
Chicago, Illinois

71590
Centrelab Electronics
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707
Coto Coil Co., Inc.
Providence, Rhode Island

71744
Chicago Miniature Lamp Works
Chicago, Illinois

71785
TRW Electronics Components
Cinch Connector Operations Div.
Elk Grove Village, Chicago, Illinois

72005
Driver, Wilber B., Co.
Newark, New Jersey

72092
Replaced by 06980

72136
Electro Motive Mfg. Co.
Williamantic, Connecticut

72259
Nytronics Inc.
Pelham Manor, New Jersey

72619
Dialight Div.
Amperex Electronic Corp.
Brooklyn, New York

72653
G.C. Electronics
Div. of Hydrometals, Inc.
Brooklyn, New York

72665
Replaced by 90303

72794
Dzus Fastener Co., Inc.
West Islip, New York

72928
Gulton Ind. Inc.
Gudeman Div.
Chicago, Illinois

72982
Erie Tech. Products Inc.
Erie, Pennsylvania

73138
Beckman Instruments Inc.
Helipot Division
Fullerton, California

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrence, California

73445
Amperex Electronic Corp.
Hicksville, LI, New York

73559
Carling Electric Inc.
West Hartford, Connecticut

73586
Circle F Industries
Trenton, New Jersey

73734
Federal Screw Products, Inc.
Chicago, Illinois

73743
Fischer Special Mfg. Co.
Cincinnati, Ohio

73899
JFD Electronics Co.
Components Corp
Brooklyn, New York

73949
Guardian Electric Mfg. Co.
Chicago, Illinois

74199
Quan Nichols Co.
Chicago, Illinois

74217
Radio Switch Corp.
Marlboro, New Jersey

74276
Signalite Div.
General Instrument Corp.
Neptune, New Jersey

74306
Piezo Crystal Co.
Carlisle, Pennsylvania

74542
Hoyt Elect. Instr. Works
Penacook, New Hampshire

74970
Johnson E.F., Co.
Waseca, Minnesota

75042
TRW Electronics Components
IRC Fixed Resistors
Philadelphia, Pennsylvania

75376
Kurz-Kasch Inc.
Dayton, Ohio

75378
CTS Knights Inc.
Sandwich, Illinois

75382
Kulka Electric Corp.
Mount Vernon, New York

75915
Littlefuse Inc.
Des Plaines, Illinois

76854
Oak Industries Inc.
Switch Div.
Crystal Lake, Illinois

77342
AMF Inc.
Potter & Brumfield Div.
Princeton, Indiana

77638
General Instrument Corp.
Rectifier Division
Brooklyn, New York

77969
Rubbercraft Corp. of CA. LTD.
Torrance, California

78189
Shakeproof
Div. of Illinois Tool Works Inc.
Elgin, Illinois

78277
Sigma Instruments, Inc.
South Braintree, Massachusetts

78488
Stackpole Carbon Co.
Saint Marys, Pennsylvania

78553
Eaton Corp. Engineered
Fastener Div.
Tinnerman Plant
Cleveland, Ohio

79136
Waldes Kohinoor Inc.
Long Island City, New York

79497
Western Rubber Company
Goshen, Indiana

79963
Zierick Mfg. Corp.
Mt. Kisko, New York

80031
Electro-Midland Corp., Mepco Div.
A North American Phillips Co.
Morristown, New Jersey

80145
LFE Corp., Process Control Div.
formerly API Instrument Co.
Chesterland, Ohio

80183 - use 56289
Sprague Products
North Adams, Massachusetts

80294
Bourns Inc., Instrument Div.
Riverside, California

80583
Hammarlund Mfg. Co., Inc.
Red Bank, New Jersey

80640
Stevens, Arnold Inc.
South Boston, Massachusetts

81073
Grayhill, Inc.
La Grange, Illinois

81312
Winchester Electronics
Div. of Litton Industries Inc.
Oakville, Connecticut

81439
Therm-O-Disc Inc.
Mansfield, Ohio

81483
International Rectifier Corp.
Los Angeles, California

81590
Korry Mfg. Co.
Seattle, Washington

81741
Chicago Lock Co.
Chicago, Illinois

82305
Palmer Electronics Corp.
South Gate, California

82389
Switchcraft Inc.
Chicago, Illinois

82415
North American Phillips
Controls Corp.
Frederick, Maryland

82872
Roanwell Corp.
New York, New York

82877
Rotron Inc.
Woodstock, New York

82879
ITT Royal Electric Div.
Pawtucket, Rhode Island

83003
Varo Inc.
Garland, Texas

83058
Carr Co., The United Can Div.
of TRW
Cambridge, Massachusetts

83298
Bendix Corp.
Electric Power Division
Eatontown, New Jersey

83330
Smith, Herman H., Inc.
Brooklyn, New York

83478
Rubbercraft Corp. of America, Inc.
West Haven, Connecticut

83594
Burroughs Corp.
Electronic Components Div.
Plainfield, New Jersey

83740
Union Carbide Corp.
Battery Products Div.
formerly Consumer Products Div.
New York, New York

84171
Arco Electronics
Great Neck, New York

84411
TRW Electronic Components
TRW Capacitors
Ogallala, Nebraska

84613
Fuse Indicator Corp.
Rockville, Maryland

84682
Essex International Inc.
Industrial Wire Div.
Peabody, Massachusetts

86577
Precision Metal Products,
of Malden Inc.
Stoneham, Massachusetts

86684
Radio Corp. of America
Electronic Components Div.
Harrison, New Jersey

86928
Seastrom Mfg. Co., Inc.
Glendale, California

87034
Illuminated Products Inc.
Subsidiary of Oak Industries Inc.
Anahiem, California

88219
Gould Inc.
Industrial Div.
Trenton, New Jersey

88245
Litton Systems Inc.
Useco Div.
Van Nuys, California

88419
Cornell-Dubilier Electronic Div.
Federal Pacific Co.
Fuquay-Varian, North Carolina

88486
Plastic Wire & Cable
Jewitt City, Connecticut

88690
Replaced by 04217

89536
Fluke, John Mfg. Co., Inc.
Seattle, Washington

89730
G.E. Co., Newark Lamp Works
Newark, New Jersey

90201
Mallory Capacitor Co. Div of
P.R. Mallory Co., Inc.
Indianapolis, Indiana

90211 - use 56365
Square D Co.
Chicago, Illinois

90215
Best Stamp & Mfg. Co.
Kansas City, Missouri

90303
Mallory Battery Co.
Div. of Mallory Co., Inc.
Tarrytown, New York

91094
Essex International Inc.
Suglex/IWP Div.
Newmarket, New Hampshire

91293
Johanson Mfg. Co.
Boonton, New Jersey

91407
Replaced by 58474

91502
Associated Machine
Santa Clara, California

91506
Augat Inc.
Attleboro, Massachusetts

91637
Dale Electronics Inc.
Columbus, Nebraska

91662
Elco Corp.
Willow Grove, Pennsylvania

91737 - use 71468
Gremar Mfg. Co., Inc.
ITT Cannon/Gremar
Santa Ana, California

91802
Industrial Devices, Inc.
Edgewater, New Jersey

91833
Keystone Electronics Corp.
New York, New York

91836
King's Electronics Co., Inc.
Tuckahoe, New York

91929
Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934
Miller Electric Co., Inc.
Div of Aunet
Woonsocket, Rhode Island

92194
Alpha Wire Corp.
Elizabeth, New Jersey

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94145
Replaced by 49956

94154 - use 94988
Wagner Electric Corp.
Tung-Sol Div.
Newark, New Jersey

94222
Southco Inc. formerly
South Chester Corp.
Lester, Pennsylvania

95146
Alco Electronic Products Inc.
Lawrence, Massachusetts

95263
Leecraft Mfg. Co.
Long Island City, New York

95264
Replaced by 98278

95275
Vitramon Inc.
Bridgeport, Connecticut

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, Ohio

95348
Gordo's Corp.
Bloomfield, New Jersey

95354
Methode Mfg. Corp.
Rolling Meadows, Illinois

95712
Bendix Corp.
Electrical Components Div.
Microwave Devices Plant
Franklin, Indiana

95987
Weckesser Co. Inc.
Chicago, Illinois

96733
San Fernando Electric Mfg. Co.
San Fernando, California

96853
Gulton Industries Inc.
Measurement and Controls Div.
formerly Rustrak Instruments Co.
Manchester, New Hampshire

96881
Thomson Industries, Inc.
Manhasset, New York

97540
Master Mobile Mounts
Div. of Whitehall Electronics Corp.
Ft. Meyers, Florida

97913
Industrial Electronic Hdware Corp.
New York, New York

97945
Penwalt Corp.
SS White Industrial Products Div.
Piscataway, New Jersey

97966
Replaced by 11358

98094
Replaced by 49956

98159
Rubber-Teck, Inc.
Gardena, California

98278
Malco A Microdot Co., Inc.
Connector & Cable Div.
Pasadena, California

98291
Sealectro Corp.
Mamaroneck, New York

98388
Royal Industries
Products Div.
San Diego, California

98743
Replaced by 12749

98925
Replaced by 14433

99120
Plastic Capacitors, Inc.
Chicago, Illinois

99217
Bell Industries Elect. Comp. Div.
formerly Southern Elect. Div.
Burbank, California

99392
STM
Oakland, California

99515
ITT Jennings Monrovia Plant
Div. of ITT Jennings formerly
Marshall Industries Capacitor Div.
Monrovia, California

99779 - use 29587
Bunker-Ramo Corp.
Barnes Div.
Landsdowne, Pennsylvania

99800
American Precision Industries Inc.
Delevan Division
East Aurora, New York

99942
Centrelab Semiconductor
Centrelab Electronics Div. of
Globe-Union Inc.
El Monte, California

Toyo Electronics
(R-Ohm Corp.)
Irvine, California

National Connector
Minneapolis, Minnesota

## Fluke Technical Service Centers — U.S. and Canada

### United States

**CALIFORNIA**
**Burbank**
Fluke Technical Center
2020 N. Lincoln St.
Zip: 91504
Tel. (213) 849-4641

**Santa Clara**
Fluke Technical Center
2300 Walsh Avenue
Zip: 95050
Tel. (408) 985-1200

**COLORADO**
**Denver**
Fluke Technical Center
1980 S. Quebec St.
Unit 4
Zip: 80231
Tel. (303) 750-1228

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**Orlando**
Fluke Technical Center
940 N. Fern Creek Ave.
Zip: 32803
Tel. (305) 896-2296

**ILLINOIS**
**Rolling Meadows**
Fluke Technical Center
1400 Hicks Road
Zip: 60008
Tel. (312) 398-5800

**MARYLAND**
**Kensington**
Fluke Technical Center
11501 Huff Court
Zip: 20795
Tel. (301) 881-6155

**MASSACHUSETTS**
**Waltham**
Fluke Technical Center
244 Second Ave.
Zip: 02154
Tel. (617) 890-1604

**MINNESOTA**
**Minneapolis**
Fluke Technical Center
10800 Lyndale Ave. So.
Zip: 55420
Tel. (612) 884-4541

**NEW JERSEY**
**Clifton**
Fluke Technical Center
460 Colfax Ave.
Zip: 07013
Tel. (201) 778-1339

**NORTH CAROLINA**
**Greensboro**
Fluke Technical Center
1310 Beaman Place
Zip: 27408
Tel. (919) 273-1918

**TEXAS**
**Dallas**
Fluke Technical Center
14400 Midway Road
Zip: 75240
Tel. (214) 233-9945

**WASHINGTON**
**Mountlake Terrace**
John Fluke Mfg. Co., Inc.
21707 66th Ave. W. Suite 1
Zip: 98043
Tel. (206) 774-2206

### Canada

**ALBERTA**
**Calgary**
Allan Crawford Assoc. Ltd.
Fluke Technical Center
14-2280 39th N.E.
Zip: T2E 6P7
Tel. (403) 276-9658

**ONTARIO**
**Mississauga**
Allan Crawford Assoc. Ltd.
Fluke Technical Center
6503 Northam Drive
Zip: L4V 1J5
Tel. (416) 678-1500

**QUEBEC**
**Longueuil**
Allan Crawford Assoc. Ltd.
Fluke Technical Center
1330 Marie Victorin Blvd. E.
Zip: J4G 1A2
Tel. (514) 670-1212

## Sales and Service Locations — International

**Supplied and supported by Fluke (Nederland) B.V., P.O. Box 5053, Zevenheuvelenweg 53, Tilburg, Netherlands.**

### EUROPE

**AUSTRIA**
*Walter Rekirsch Elektronische
Gerate GmbH & Co. Vertrieb KG.
Liechtensteinstrasse 97/6
A-1090 Vienna, Austria
Tel. (222) 347646-0

**BELGIUM**
*C. N. Rood S/A
37 Place de Jamblinne de Meux
B-1040 Brussels, Belgium
Tel. (02) 27352135

**CYPRUS**
Chris Radiovision Ltd.
P.O. Box 1989
Nicosia, Cyprus
Tel. 66121

**DENMARK**
*Tage Olsen A/S
Ballerup Byveg 222
DK-2750 Ballerup
Tel. (01) 2-65 81 11

**FINLAND**
*Oy Findip AB
Teollisuustie 7
02700 Kauniainen
Helsinki, Finland
Tel. (080) 502255

**FRANCE**
*M. B. Electronique S.A.
Rue Fourney
ZAC de BUC
B. P. No. 31
78530 BUC, France
Tel. (01) 9563130

**GERMAN FEDERAL REPUBLIC**
*Fluke (Deutschland) GmbH
4-Dusseldorf
Meineckestrasse 53
West Germany
Tel. 211-450831

*Fluke (Deutschland) GmbH
8000 Munich 80
Vertriesburo Bayern
Rosenheimer Strasse 139
West Germany
Tel. 089-404061

**GREECE**
*Hellenic Scientific
Representations Ltd.
11 Vrassida Street
Athens 612, Greece
Tel. (021) 7792320

**ITALY**
*Sistrel S.p.A.
Via Giuseppe Armellini No. 39
00143 Rome, Italy
Tel. (06) 5915551

*Sistrel S.p.A.
Via Timavo 66
20099 Sesto S. Giovanni (Milan)
Italy
Tel. (02) 2476693

**NETHERLANDS**
*C.N. Rood, B.V.
Cort van der Lindenstraat 11-13
Rijswijk ZH2280AA
Netherlands
Tel. (070) 996360

**NORWAY**
*Morgenstierne & Co. A/A
Konghellegate 3
P.O. Box 6688, Rodelokka
Oslo 5, Norway
Tel. (02) 356110

**PORTUGAL**
*Equipamentos
De Laboratorio Ltda.
P.O. Box 1100
Lisbon 1, Portugal
Tel. (019) 976551

**SPAIN**
*Hispano Electronica S.A.
Poligono Industrial Urtinsa
Apartado de Correos 48
Alcorcon (Madrid), Spain
Tel. 09-341-6194108

**SWEDEN**
*Teleinstrument AB
P.O. Box 490
S-162 Vallingby-4
Sweden
Tel. (08) 380370

**SWITZERLAND**
*Traco Electronic AG
Jenatschstrasse 1
8002 Zurich, Switzerland
Tel. (01) 2010711

**TURKEY**
*Erkman Electronik Aletler
Necatibey Cad 92/2
Karakoy/Istanbul
Turkey
Tel. 441546

**UNITED KINGDOM**
*Fluke International Corp.
Colonial Way
Watford Herts WD2 4TT, England
Tel. (0923) 40511

### MIDDLE EAST

**EGYPT**
Lotus Engineering Organisation
P.O. Box 1252
Cairo, Egypt
Tel. 71617

**IRAN**
*Irantronics Company Ltd.
20 Salm Road, Roosevelt Ave.
Tehran, Iran
Tel. 828294

**ISRAEL**
*R.D.T. Electronics
Engineering Ltd.
46, Sokolov Street
Ramat Hasharon 47235, Israel
Tel. 482311

**JORDAN**
Trading & Agricultural
Development Co.
P.O. Box 567
Amman, Jordan
Tel. 23052

**KUWAIT**
Tareq Company
P.O. Box Safat 20506
Kuwait, Arabian Gulf
Tel. 436100

**LEBANON**
Mabek
P.O. Box 11-3823
Beirut, Lebanon
Tel. 252631

**MOROCCO**
Mainvest
Residence Moulay Ismail
Bat.C Boulevard
Moulay Slimane, Rabat, Morocco
Tel. 276-64

**SAUDI ARABIA**
Electronic Equipment
Marketing Est.
P.O. Box 3750
Riyadh, Saudi Arabia
Tel. 32700

**SYRIA**
Mabek Electronics
C/O Messers G. Ghazzi
P.O. Box 4238
Damascus, Syria

***Technical Service Available**

Customers in the following countries: Bulgaria, Czechoslovakia, Hungary, Poland, Romania, U.S.S.R. and Yugoslavia. Contact: Amtest Associates Ltd., P.O. Box 55, Addlestone, Surrey, KT 15 1DU, England, Tel. (0932) 52121

## Sales and Service Locations — International (Concluded)

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**ARGENTINA**
*Coasin S.A.
Virrey del Pino 4071
Buenos Aires, Argentina
Tel. 523185

**AUSTRALIA**
*Elmeasco Instruments Pty. Ltd.
P.O. Box 30
Concord, N.S.W.
Australia 2137
Tel. (02) 736-2888

Elmeasco Instruments Pty. Ltd.
P.O. Box 107
Mt. Waverly, VIC 3149
Australia
Tel. 233-4044

**BANGLADESH**
Kabir Brothers Ltd.
97 - Gulshan Ave., Gulshan
G.P.O. Box 693
Dacca-12, Bangladesh
Tel. 303104

**BOLIVIA**
Coasin Bolivia S.R.L.
Casilla 7295
La Paz, Bolivia
Tel. 40962

**BRAZIL**
*Arotec S.A.
Industrial e Comercio
Av. Pacaembu 811
Sao Paulo S.P., Brazil
Tel. (67) 2393

*Arotec S.A.
Av. Rio Branco, 277
Grupo 1309
Rio de Janeiro - R. J., Brazil

**CHILE**
*Intronica Chile Ltda.
Casilla 16228
Manuel Montt 024-Of. D
Santiago 9, Chile
Tel. 44940

**COLOMBIA**
Coasin Ltda.
Carrera 13, No. 37-37, Of. 407
Ap. Aereo 29583
Bogota DE, Colombia
Tel. 285-0230

**ECUADOR**
*Proteco Coasin CIA, Ltda.
Edifica "Jerico"
Ave. 12 de Octubre
No. 2285 y Ave. Orellana
(Planta Baja)
Quito, Ecuador
Tel. 529-684

**HONG KONG**
*Gilman & Co., Ltd.
P.O. Box 56
Hong Kong
Tel. 794266

**ICELAND**
Kristjan O. Skagfjord Ltd.
P.O. Box 906
Reykjavik, Iceland
Tel. 24120

**INDIA**
*Hinditron Services Pvt. Ltd.
69/A.L. Jagmohandas Marg
Bombay 400 006, India
Tel. 365344

*Hinditron Services Pvt. Ltd.
412 Raj Mahal Vilas Extn.
Bangalore 560 006, India
Tel. 33139

**INDONESIA**
*P.T. DWI Tunggal Jaya Sakti
Sangga Buana Bldg., 1st Floor
J1 Senen Raya 44, P.O. Box 4435
Jakarta, Indonesia
Tel. 367390

P.T. DWI Tunggal Jaya Sakti
Jalan Sasakgantung 45
Bandung, Indonesia

**JAPAN**
Panetron Division
Tokyo Electron Ltd.
1 Higashikata-machi
Midori-ku
Yokohama 226, Japan
Tel. (045) 471-8811

*John Fluke Mfg. Co., Inc.
1 Higashikata-machi
Midori-ku
Yokohama 226, Japan
Tel. (045) 473-5425
Tlx: 3823-666 FLUKJP J

**KENYA**
Adcom Limited Inc.
P.O. Box 30070
Nairobi, Kenya
East Africa
Tel. 331955

**KOREA**
*Electro-Science Korea Co.
C.P.O. Box 8446
Rm. 1201 Bowon Bldg.
490 Chongro-5Ka
Chongro-ku
Seoul, Korea
Tel. 261-7702

**MALAYSIA**
O'Connor's (Pte) Ltd.
P.O. Box 1197
Kota Kinabalu, Sabah
East Malaysia
Tel. 54082

O'Connor's (Pte) Ltd.
P.O. Box 91
Petaling Jaya, Selangor
West Malaysia
Tel. 51563

**MEXICO**
*C.J. Christensen S.A. de C.V.
Instrumentos Electronicos
de Medicion
Melchor Ocampo 150-8
Mexico 4, D.F., Mexico
Tel. (905) 535-2258

**NEW ZEALAND**
*W & K McLean Ltd.
P.O. Box 3097
Auckland, New Zealand
Tel. 587-037

**NIGERIA**
Mofat Engineering Co., Ltd.
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Lagos, Nigeria

**PAKISTAN**
Pak International Operations
505 Muhammadi House
McLeod Road
P.O. Box 5323
Karachi, Pakistan
Tel. 221127

**PERU**
*Importaciones
y Representaciones
Electronicas S.A.
Avda, Franklin D. Roosevelt 105
Lima 1, Peru
Tel. 288650

**SINGAPORE**
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Tel. 637944

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*Fluke S.A. (Pty) Ltd.
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Bramley 2018
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Tel. (011) 786-3170

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CCT Associates, Inc.
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Taipei, Taiwan
Republic of China
Tel. (02) 391-6894

**THAILAND**
Dynamic Supply
Engineering R.O.P.
No. 56 Ekamai, Sukhumvit 63
Bankok 11, Thailand
Tel. 914434

**URUGUAY**
Coasin Uruguaya S.R.L.
Cerrito 617-4° Piso
Montevideo, Uruguay
Tel. 917978

**VENEZUELA**
*Coasin C.A.
APDO Postal 50939
Sabana Grande No. 1
Caracas 105, Venezuela
Tel. 782-9109

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## Sales Offices — U.S. and Canada

**John Fluke Mfg. Co., Inc.**
P.O. Box 43210, Mountlake Terrace, WA 98043
Tel. (206) 774-2211 Toll Free: (800) 426-0361 TWX: 910-449-2850 TLX: 32-0013 Cable: Fluke

### United States

**AK, Anchorage**
Harry Lang & Associates
1406 W. 47th Ave.
Anchorage, AK 99503
(907) 279-5741

**AL, Huntsville**
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Huntsville, AL 35807
(205) 881-6220

**AZ, Phoenix**
John Fluke Mfg. Co., Inc.
7319 E. Stetson Drive
Scottsdale, AZ 85251
(602) 994-3883

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2020 N. Lincoln Blvd.
Burbank, CA 91504
(213) 849-7181

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John Fluke Mfg. Co., Inc.
2300 Walsh Ave.
Santa Clara, CA 95050
(408) 244-1505

**CA, Tustin**
John Fluke Mfg. Co., Inc.
15441 Red Hill Ave, Unit B
Tustin, CA 92680
(714) 752-6200

**CO, Denver**
Barnhill Three, Inc.
1980 S. Quebec St., Unit 4
Denver, CO 80231
(303) 750-1222

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John Fluke Mfg. Co., Inc.
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Glastonbury, CT 06033
(203) 633-0777

**FL, Orlando**
John Fluke Mfg. Co., Inc.
940 N. Fern Creek Ave.
Orlando, FL 32803
(305) 896-4881

**HI, Honolulu**
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2979 Ualena St.
Honolulu, HI 96819
(808) 847-1138

**IL, Chicago**
John Fluke Mfg. Co., Inc.
1400 Hicks Road
Rolling Meadows, IL 60008
(312) 398-0850

**IN, Indianapolis**
John Fluke Mfg. Co., Inc.
5610 Crawfordsville Rd.
Suite 802
Indianapolis, IN 46224
(317) 244-2456

**MA, Waltham**
John Fluke Mfg. Co., Inc.
244 Second Avenue
Waltham, MA 02154
(617) 890-1600

**MD, Baltimore**
John Fluke Mfg. Co., Inc.
11501 Huff Court
Kensington, MD 20795
(301) 881-3370
(301) 792-7060 (Baltimore)

**MI, Detroit**
John Fluke Mfg. Co., Inc.,
13955 Farmington Rd.
Livonia, MI 48154
(313) 522-9140

**MN, Minneapolis**
John Fluke Mfg. Co., Inc.
10800 Lyndale Ave. S.
Minneapolis, MN 55420
(612) 884-4336

**MO, Kansas City**
John Fluke Mfg. Co., Inc.
4406 Chouteau Traffic Way
Kansas City, MO 64117
(816) 454-5836

**MO, St. Louis**
John Fluke Mfg. Co., Inc.
300 Brooks Dr., Suite 100
Hazelwood, MO 63042
(314) 731-3388

**NC,, Greensboro**
John Fluke Mfg. Co., Inc.
1310 Beaman Place
Greensboro, NC 27408
(919) 273-1918

**NJ, Clifton**
John Fluke Mfg. Co., Inc.
460 Colfax Avenue
Clifton, NJ 07013
(201) 778-4040
(516) 935-6672 (Long Island)

**NM, Albuquerque**
Barnhill Three, Inc.
1410 D Wyoming N.E.
Albuquerque, NM 87112
(505) 299-7658

**NY, Rochester**
John Fluke Mfg. Co., Inc.
4515 Culver Road
Rochester, NY 14622
(716) 266-1400

**OH, Cleveland**
John Fluke Mfg. Co., Inc.
7830 Freeway Circle
Middleburg Heights, OH 44130
(216) 234-4540

**OH, Dayton**
John Fluke Mfg. Co., Inc.
4756 Fishburg Rd.
Dayton. OH 45424
(513) 233-2238

**PA, Philadelphia**
John Fluke Mfg. Co., Inc.
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King of Prussia, PA 19406
(215) 265-4040

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John Fluke Mfg. Co., Inc.
111 W. Anderson Lane
Suite 213
Austin ,TX 78752
(512) 458-6279

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John Fluke Mfg. Co., Inc.
14400 Midway Road
Dallas, TX 75240
(214) 233-9990

**TX, Houston**
John Fluke Mfg. Co., Inc.
1014 Wirt Road, Suite 270
Houston, TX 77055
(713) 683-7913
(512) 222-2726 (San Antonio)

**UT, Salt Lake City**
Barnhill Three, Inc.
54 West 2100 South
Suite 3
Salt Lake City, UT 84115
(801) 484-4496

**WA, Seattle**
John Fluke Mfg. Co., Inc.
691 Strander Blvd.
Seattle, WA 98168
(206) 575-3765

### Canada

**ALB, Calgary**
Allan Crawford Assoc., Ltd.
2280 - 39th N.E.
Calgary, ALB T2E 6P7
(403) 276-9658

**BC, North Vancouver**
Allan Crawford Assoc., Ltd.
3795 William Street
Burnaby, BC Y5C 3H3
(604) 294-1326

**NS, Halifax**
Allan Crawford Assoc., Ltd.
Suite 201, Townsend Pl.
800 Windmill Road
Burnside Industrial Park
Dartmouth, NS B3B 1L1
(902) 469-7865

**ONT, Ottawa**
Allan Crawford Assoc., Ltd.
1299 Richmond Road
Ottawa, ONT K2B 7Y4
(613) 829-9651

**ONT, Toronto**
Allan Crawford Assoc., Ltd.
6503 Northam Drive
Mississauga, ONT L4V 1J5
(416) 678-1500

**QUE, Montreal**
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1330 Marie Victorin Blvd. E.
Longueuil, QUE J4G 1A2
(514) 670-1212

For Canadian areas not listed, contact the office nearest you or Allan Crawford Assoc. Ltd., Mississauga (Toronto), Ontario.

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# Section 8
# Schematic Diagrams

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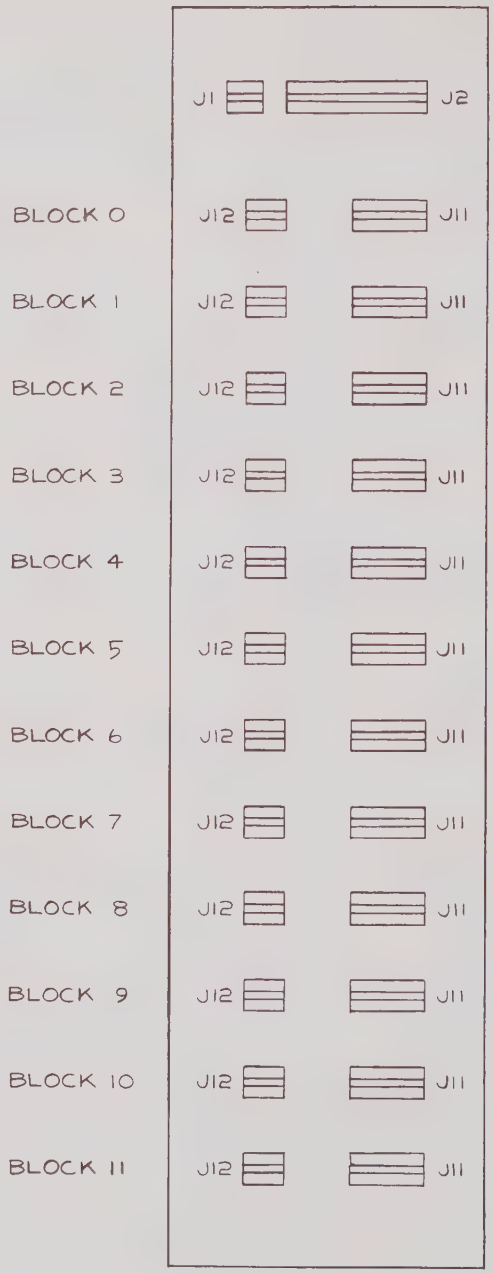
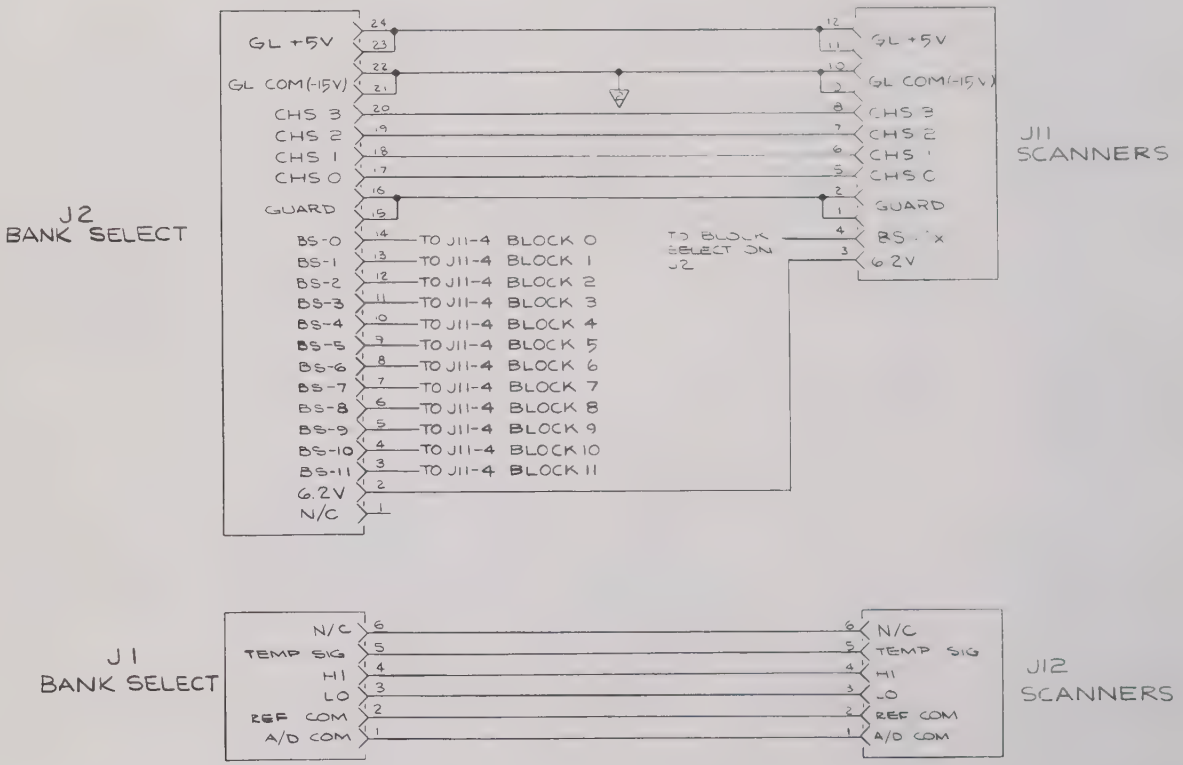



**Figure 8-1. A1 Mother Board PCB Assembly**

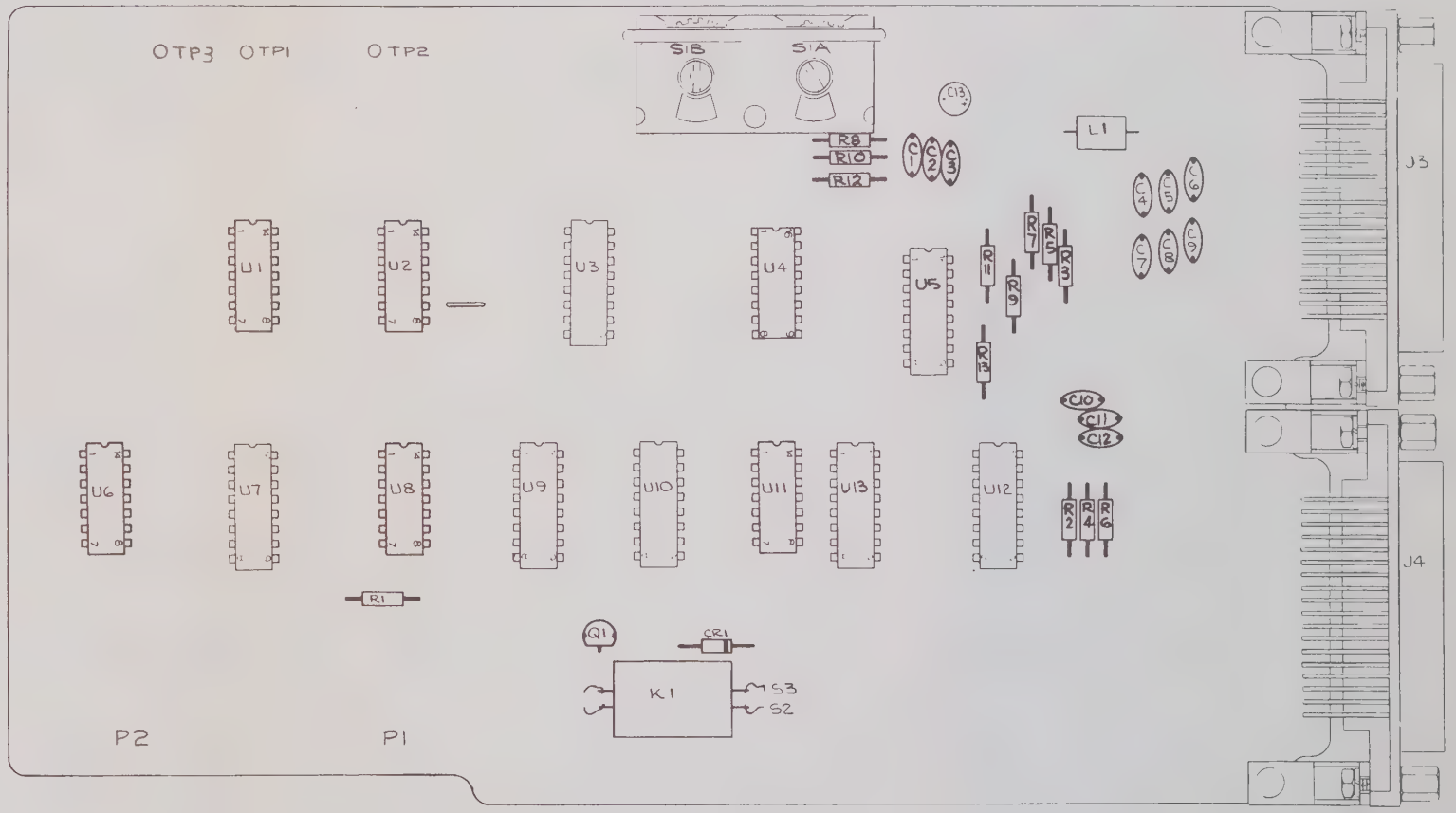
NOTES:

1. ▽ DENOTES GUARDED LOGIC COMMON [GL COM (-15V)] WHICH IS -15V WITH RESPECT TO A/D COMMON.
2. ALL GRAPHIC SYMBOLS ARE IN ACCORDANCE WITH ANSI Y32.2 AND Y32.14.



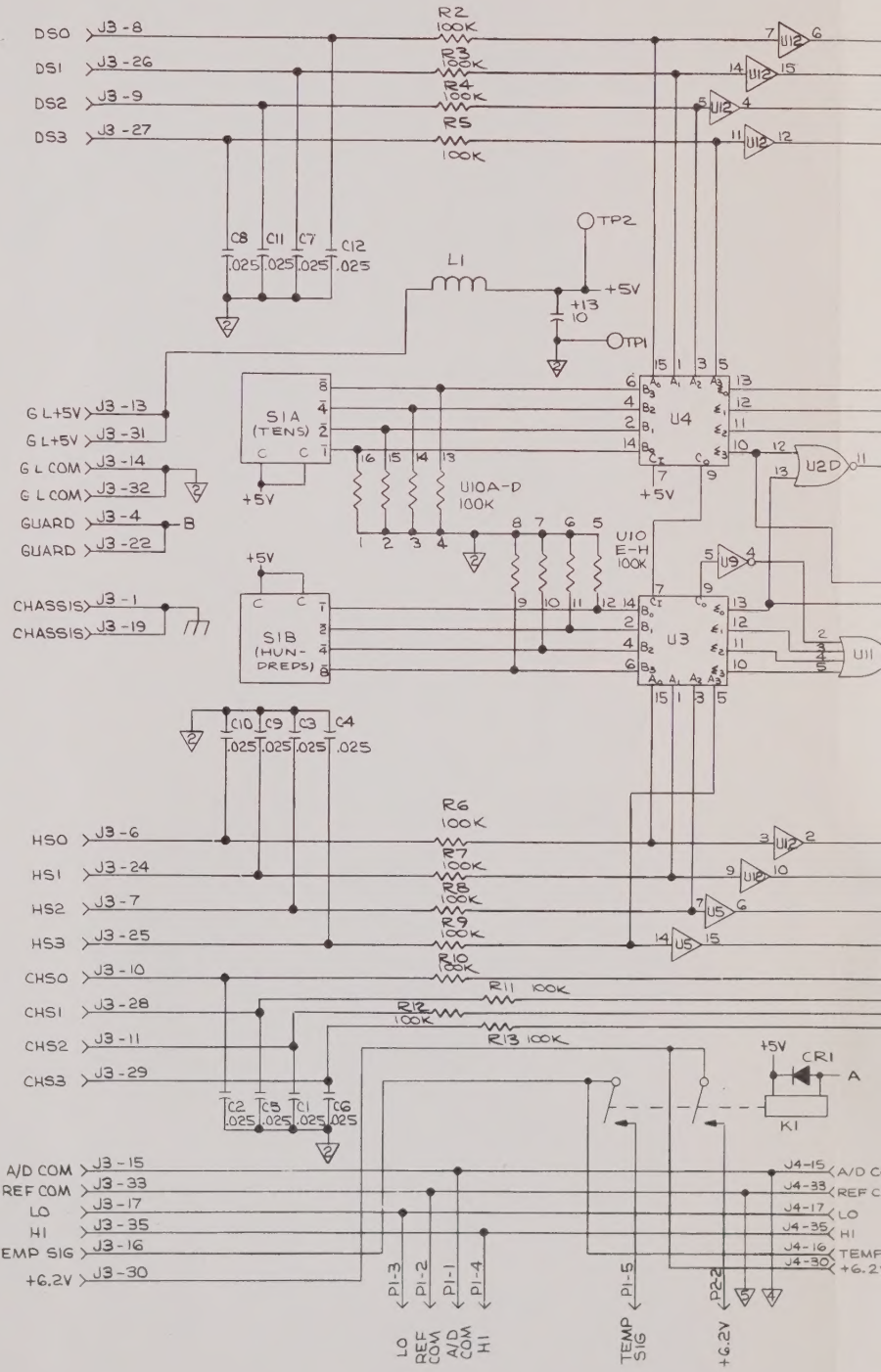

2201A-1001

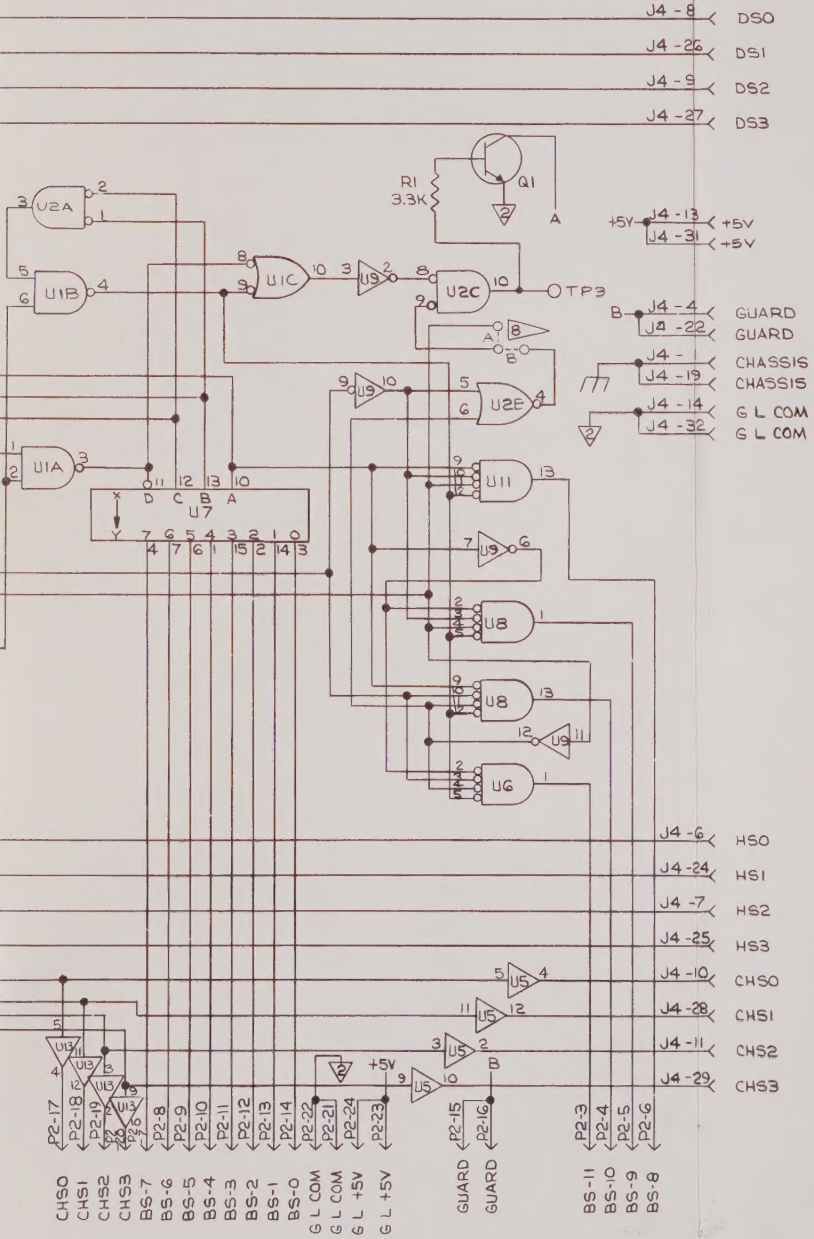
Figure 8-1. A1 Mother Board PCB Assembly (cont)




2201A-1602

Figure 8-2. A2 Bank Select PCB Assembly


DS0 J3-8
DS1 J3-26
DS2 J3-9
DS3 J3-27
R2 100K
R3 100K
R4 100K
R5 100K
C8 .025
C11 .025
C7 .025
C12 .025
L1
TP2
+5V
+13
10
TP1
G L+5V J3-13
G L+5V J3-31
G L COM J3-14
G L COM J3-32
GUARD J3-4
GUARD J3-22
S1A (TENS)
U4
U10A-D 100K
U2D
CHASSIS J3-1
CHASSIS J3-19
S1B (HUNDREDS)
U10 E-H 100K
U3
U9
U11
C10 .025
C9 .025
C3 .025
C4 .025
HS0 J3-6
HS1 J3-24
HS2 J3-7
HS3 J3-25
CHS0 J3-10
CHS1 J3-28
CHS2 J3-11
CHS3 J3-29
R6 100K
R7 100K
R8 100K
R9 100K
R10 100K
R11 100K
R12 100K
R13 100K
U12
U5
C2 .025
C5 .025
C1 .025
C6 .025
CR1
A
K1
A/D COM J3-15
REF COM J3-33
LO J3-17
HI J3-35
TEMP SIG J3-16
+6.2V J3-30
P1-3
P1-2
P1-1
P1-4
P1-5
P2-2
J4-15 A/D C
J4-33 REF C
J4-17 LO
J4-35 HI
J4-16 TEMP
J4-30 +6.2
LO
REF COM
A/D COM
HI
TEMP SIG
+6.2V




NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. FOR ASSY DWG SEE 2201-4002.
3. ALL RESISTORS ARE 1/4 W, 5% UNLESS OTHERWISE NOTED.
4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.14 AND Y32.2.
5. (2) DENOTES GUARDED LOGIC COMMON (G L COM).
6. (4) DENOTES A/D COMMON (A/D COM).
7. (5) DENOTES REFERENCE COMMON (REF COM).
8. 100(A)/120(B) CHANNEL JUMPER

| IC | PIN NUMBER | |
|---|---|---|
| REF DES | G L +5V | G L COM |
| U1 | 14 | 7,12,13 |
| U2 | 14 | 7 |
| U3 | 16 | 8 |
| U4 | 7,16 | 8 |
| U5 | 1,16 | 8 |
| U6 | 16 | 8,9,10,11,12 |
| U7 | 16 | 8 |
| U8 | 16 | 8 |
| U9 | 1,16 | 8,14 |
| U10 | – | 8 |
| U11 | 14 | 7 |
| U12 | 1,16 | 8 |
| U13 | 1,16 | 7,8,14 |

| REFERENCE DESIGNATIONS | | | |
|---|---|---|---|
| LAST USED | | NOT USED | |
| C13<br>CR1<br>K1<br>Q1 | R13<br>S1<br>TP3<br>U13 | | |

2201A-1002

Figure 8-2. A2 Bank Select PCB Assembly (cont)

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